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Revision 0

Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site, Fiscal Year 2007

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Richland, Washington

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S. D. Aardal 11/06/2007
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EXECUTIVE SUMMARY

The Hanford Site's 200 Area Effluent Treatment Facility (ETF) processes contaminated aqueous wastes derived from Hanford Site facilities. The treated wastewater occasionally contains tritium, which cannot be removed by the ETF prior to the wastewater being discharged to the 200 Area State-Approved Land Disposal Site (SALDS). During the first 10 months of fiscal year 2007 (FY07) (through July 31, 2007), approximately 13.9 million L (3.67 million gal) of water were discharged to the SALDS.

Groundwater monitoring for tritium and other constituents, as well as water-level measurements, is required for the SALDS by *State Waste Discharge Permit Number ST-4500* (Ecology 2000). The current network consists of 3 proximal (compliance) monitoring wells and 11 tritium-tracking wells. Quarterly sampling of the proximal wells occurred in October 2006 and in January/February plus April and July 2007. Water levels at two of the three wells are adequate for the foreseeable future; another well (699-48-77A) appears to be on the verge of going dry before FY09 unless more continuous waste streams are routed to the ETF.

The 11 tritium-tracking wells include groundwater monitoring wells located upgradient and downgradient of the SALDS. Annual sampling at these wells occurred in January through May 2007. Sampling results from the tritium-tracking wells, especially those located south of the SALDS, are used to calibrate the groundwater modeling. The number of wells in this group has decreased as regional groundwater levels have declined.

Water-level measurements taken in the three proximal SALDS wells indicate that a small hydraulic mound is present beneath the facility, which is a result of operational discharges. This mound directs groundwater flow so it moves radially outward a short distance and then moves to the east-northeast under the regional hydraulic gradient. The groundwater mound places several wells south of the SALDS hydraulically cross-gradient or downgradient of the facility. Under the regional flow system, these wells would be upgradient. The hydraulic mound is expected to increase in FY08 with the restart of the 200-UP-1 Operable Unit pump-and-treat system and the addition of treated groundwater and from groundwater around the 241-T Tank Farm.

Originally, 15 groundwater wells along the northern edge of the 218-W-3A, 218-W-3AE, and 218-W-6 Low Level Burial Grounds (LLBG) were identified for tritium tracking, and as a means of confirming groundwater modeling results. At present, 4 wells located south of the SALDS can be sampled because the regionally declining water table has dropped below the screens at the other 11 wells. The tritium-tracking well system is generally adequate to monitor the arrival of tritium, except for wells located south of the SALDS, near LLBG-3/5, where a minimal well density exists.

Average tritium activities decreased or rose only slightly in two of three proximal wells during FY07, similarly to FY06. Sporadic detections of tritium in well 299-W7-5, near the LLBG, are from a pre-existing plume originating in the 200 West Area. Maximum FY07 tritium activities for the SALDS proximal wells were 56,000 pCi/L in well 699-48-77A (July 2007), 82,000 pCi/L in well 699-48-77C (October, 2006), and 130,000 pCi/L in well 699-48-77D (April and July 2007). To date, no positive indications of a tritium incursion from the SALDS have been detected in the tritium-tracking wells.

Concentrations of all chemical constituents were within Permit limits during all of FY07 (Table 3-2). Acetone, benzene, cadmium, chloroform, and tetrahydrofuran were below method detection limits in all proximal well samples. Other key analytes were found at below-limit concentrations in one or more wells. After trending upward for several years, concentrations of major cations and anions have dropped below baseline concentrations due to dilution by the treated water discharged to the SALDS.

A numerical model of the top of the upper aquifer (water table) and tritium plume distribution over time was completed as part of the process to renew the SALDS discharge permit (PNNL-14898). The numerically simulated water table is generally 1.5 to 2.0 m (5.0 to 6.6 ft) higher than the measured water table in wells around the SALDS facility. This discrepancy may be because the water table under initial conditions in the Hanford Sitewide groundwater model has been shown to be about 1 m (3.3 ft) higher than measured field conditions. The numerical model predicts that the edge of the tritium plume should reach the line of tritium-tracking wells along the northern edge of the 200 West Area between the years 2020 and 2030. If the water table continues to decline at the current rate (0.27 m/yr [0.9 ft/yr]), only the wells screened deep in the aquifer will survive until 2020 or later, when the tritium plume is expected to reach the northern boundary of the 200 West Area.

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TABLES

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LIST OF TERMS

ETF	Effluent Treatment Facility
FY	fiscal year
gpm	gallons per minute
HWIS	Hanford Well Information System
LLBG	Low-Level Burial Grounds
NTU	nephelometric turbidity unit
SALDS	State-Approved Land Disposal Site

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

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1.0 INTRODUCTION

Treated water from the Hanford Site's 200 Area Effluent Treatment Facility (ETF) is discharged to the 600-211 State-Approved Land Disposal Site (SALDS) as allowed by *State Waste Discharge Permit Number ST-4500* (Ecology 2000). The Permit allows disposal of ETF effluents to the drain field, located 360 m (1,200 ft) north of the 200 West Area (Figure 1-1). In accordance with the Permit, groundwater in the vicinity of the SALDS is routinely sampled for tritium and water-level measurements are collected. Gross alpha, gross beta, strontium-90, and tritium are not assigned enforcement limits but are monitored and reported for informational purposes. This Permit also requires submitting an annual tritium-tracking report and a groundwater monitoring plan that covers the 5-year period of the Permit. The current plan (PNNL-13121) provides additional guidance for selecting and reporting groundwater analyses. The results of groundwater sampling and analysis are also reported in quarterly discharge monitoring reports issued by Fluor Hanford, Inc.

1.1 OBJECTIVE AND SCOPE

This report presents the results of groundwater monitoring and tritium-tracking samples from the SALDS facility during fiscal year 2007 (FY07). Due to the 30-day turnaround for analysis of proximal well groundwater samples, this report addresses data from August 1, 2006, through July 31, 2007. Updated background information, which necessary to understand the results of the groundwater analyses, is also provided on facility operations. Interpretive discussions and recommendations for future monitoring are also provided, where possible. Analytical results from sampling rounds scheduled for September 2007 will be included in the FY08 report.

1.2 BACKGROUND

Background information presented in this section is based on the *Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site* (PNNL-13121). New information on hydrogeology, modeling comparison, and discharges is also provided, where available.

The primary requirements of the Permit are that a groundwater monitoring plan must be agency-approved and that analytical results must be compared annually with Permit-prescribed limits. These comparisons are presented in tabular form and are discussed in Section 3.0 of this report. The groundwater monitoring plan includes the following objectives:

- Tracking changes in groundwater quality associated with the SALDS discharges
- Determining why these changes have occurred
- Tracking the migration rate of tritium in groundwater originating from the SALDS
- Comparing model predictions with observed results for the purpose of refining predictive capability
- Correlating discharge events at SALDS with analytical results from groundwater monitoring
- Ensuring that groundwater data are accurately interpreted.

The groundwater monitoring well network (Figure 1-2) was designed to address these objectives using the existing wells shared with other nearby facilities (e.g., the Low-Level Burial Grounds [LLBG]) and dedicated wells drilled specifically for SALDS monitoring.

1.2.1 Hydrogeologic Setting and Conceptual Model

The nature of the geologic formations beneath the SALDS facility accounts for peculiarities in the movement of the SALDS effluent downward to the groundwater, as described in PNNL-13121. Groundwater chemical analyses indicate that well 699-48-77A, the southernmost but upgradient proximal well furthest from the SALDS, responded to discharges several months earlier than well 699-48-77D and approximately 2 years earlier than well 699-48-77C. The carbonate-cemented horizons of the Cold Creek unit occur within the vadose zone a few feet below the bottom of the SALDS drain field. This stratum consists of a thick, but locally discontinuous, layer of highly impermeable silt, gravel, and sand with significant interstitial calcium carbonate and other minerals as cementation. Effluent from the SALDS is diverted southward along the gentle dip of this horizon until a discontinuity or significant fracture is reached, whereupon it migrates downward into the Ringold Formation. This circumstance allows the infiltrating effluent to first reach groundwater at the more distant and southernmost proximal well (699-48-77A). Figure 1-3 presents the conceptual model for the SALDS and shows how discharges are thought to move to the water table. A more detailed conceptual model is presented in the FY03 annual report (PNNL-14449).

Sedimentary units beneath the SALDS (i.e., Ringold Formation, Cold Creek unit, and Hanford formation) have been shown to contain leachable minerals such as calcium carbonate and sulfate-bearing minerals (WHC-SD-C018H-RPT, PNNL-13757-1). All three of these strata occur beneath the SALDS, extending from near the surface to approximately 75 m (246 ft) deep in the vadose zone. Natural mineral accumulations in these formations contribute a considerable load of dissolved solids to the groundwater as SALDS effluent percolates to the water table.

1.2.2 Groundwater Modeling

The Permit requires running an updated numerical groundwater model at least once during a permit cycle (i.e., every 5 years) to predict tritium movement and the distribution of tritium in the aquifer as a result of SALDS discharges. The Permit also requires that the model be reapplied "within 6 months of detection of the tritium plume in a new monitoring well." This requirement indicates that the numerical model will be reapplied when the tritium plume associated with the SALDS is positively identified in a location not predicted by the most recent model run, or within a well not previously affected by an incursion of SALDS-derived tritium. To date, no positive indications of tritium incursion have been detected in a new monitoring well.

The most recent model application was conducted in 2004 (PNNL-14898). The model output graphically illustrates the predicted head distribution and tritium concentrations in groundwater near the SALDS for selected timeframes between 1996 and 2095. The updated model incorporates recent refinements to the Hanford Sitewide groundwater model and actual water volume and tritium release information reported through June 2004. Section 4.0 compares the most recent monitoring results to the updated numerical simulations.

1.2.3 State-Approved Land Disposal Discharge Information

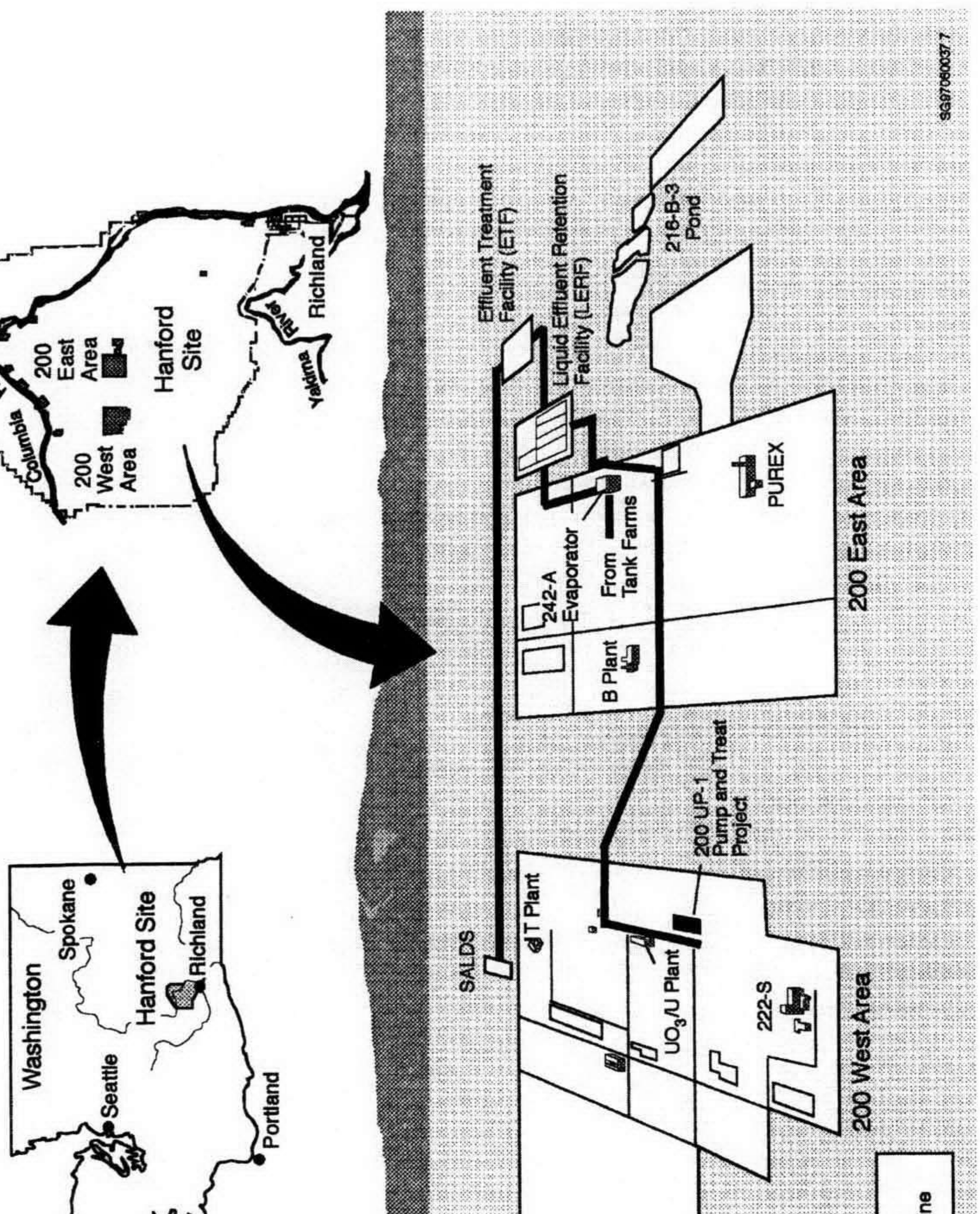
During FY07 (from October 1, 2006, through July 31, 2007), approximately 13.9 million L (3.67 million gal) of water were discharged to the SALDS, compared to approximately 13.2 million L (3.5 million gal) in FY06 and 36.7 million L (9.8 million gal) during the same period in FY05. The FY07 waste streams include the K-East and K-West Basins streams, the Cold Vacuum Drying Facility, and the Environmental Restoration Disposal Facility leachate streams. The highest discharge to the crib occurred in March 2007 when 2.36 million L (622.9 thousand gal) were received. Total discharge volume to the SALDS since December 1995 is over 794 million L (209.8 million gal) (Figure 1-4).

The first release of clean, tritium-rich water from the ETF to the SALDS occurred in December 1995. During that month and the subsequent 6 months, a total of 220 Ci of tritium were released, which is an amount that comprises about 59% of the total inventory released to date. Discharge volumes of clean water remained relatively constant until FY05, with an average of approximately 95 million L (25 million gal) received each year. Starting in FY05, tritium consignments discharged to the site have been as sporadic as was observed since the 7-month period at the beginning of operations due to cessation of treating groundwater from the 200-UP-1 pump-and-treat system. For the last 2 years, intermittent campaigns have been conducted to treat 242-A evaporator process condensate and K Basins Project waste streams, which supply most of the tritium to the facility.

Beginning in April 2007, the 200-UP-1 pump-and-treat system restarted and has pumped groundwater to the Liquid Effluent Retention Facility Basin 43 at an average rate of approximately 43.2 L/min (11.4 gallons per minute [gpm]) for treatment of uranium, technetium-99, carbon tetrachloride, and nitrate. A waste stream (approximately 150-170 L/min [40-45 gpm]) from the 241-T pump-and-treat system will be sent to the ETF for treatment in FY08. The contaminants of concern are technetium-99, carbon tetrachloride, trichloroethene, nitrate, uranium, tritium, and chromate. These streams will significantly increase the amount of groundwater discharged to the SALDS. Tritium concentrations are expected to range between 5,000 to >20,000 pCi/L.

The total quantity of tritium discharged to the SALDS during FY06 was approximately 25.4 Ci, reflecting the higher concentrations of tritium in the waste stream. The total quantity of tritium discharged to the SALDS from December 1995 through July 2007 was approximately 402 Ci. Monthly and cumulative quantities of tritium discharged to the SALDS are presented in Figure 1-5.

Figure 1-1. Location of the State-Approved Land Disposal Site and Related Infrastructure.



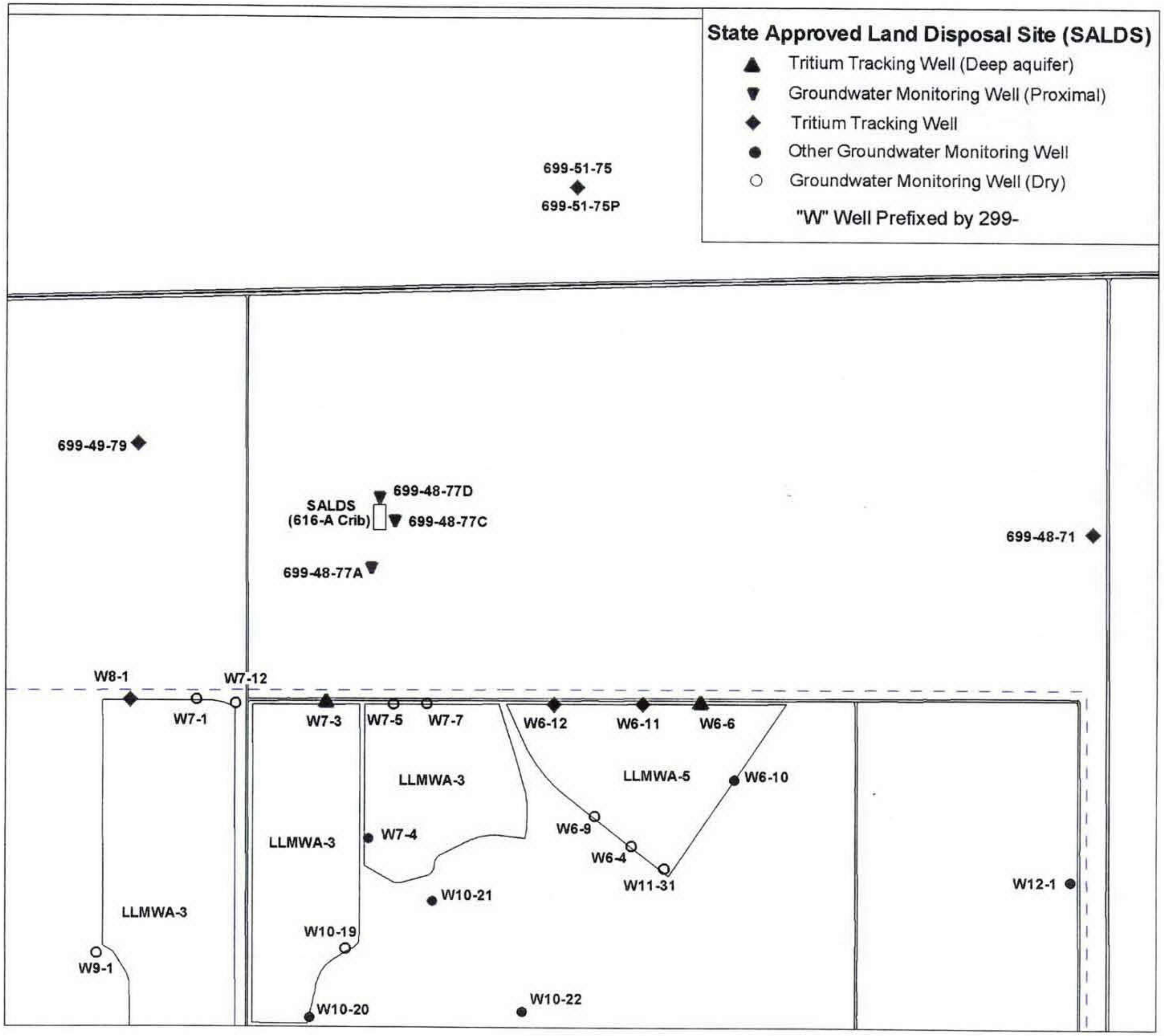


Figure 1-2. Locations of State-Approved Land Disposal Site Groundwater Monitoring and Tritium-Tracking Network Wells.

Figure 1-3. Conceptual Diagram of State-Approved Land Disposal Site Operational Effects.

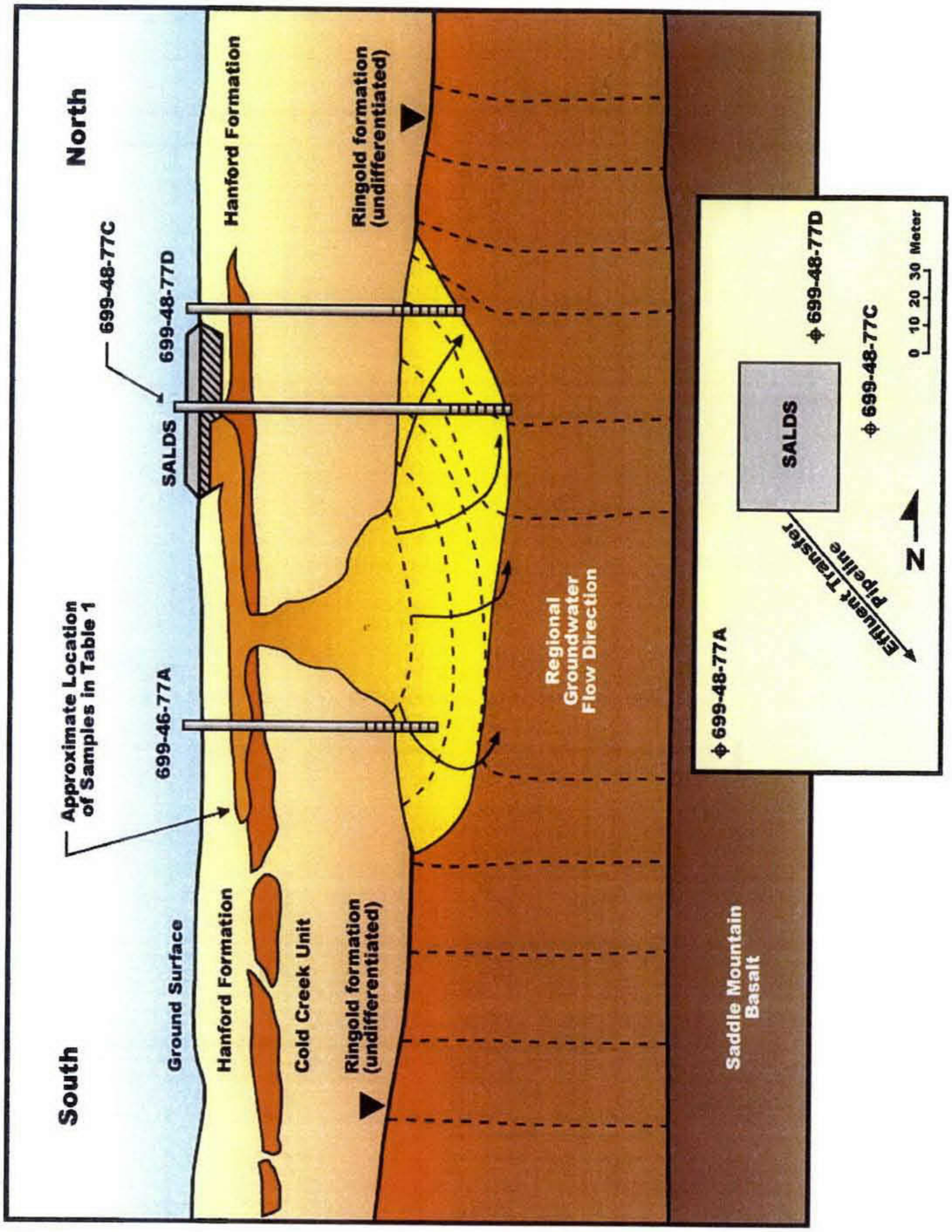


Figure 1-4. Monthly and Cumulative Discharge Volumes for the State-Approved Land Disposal Site through July 2007.

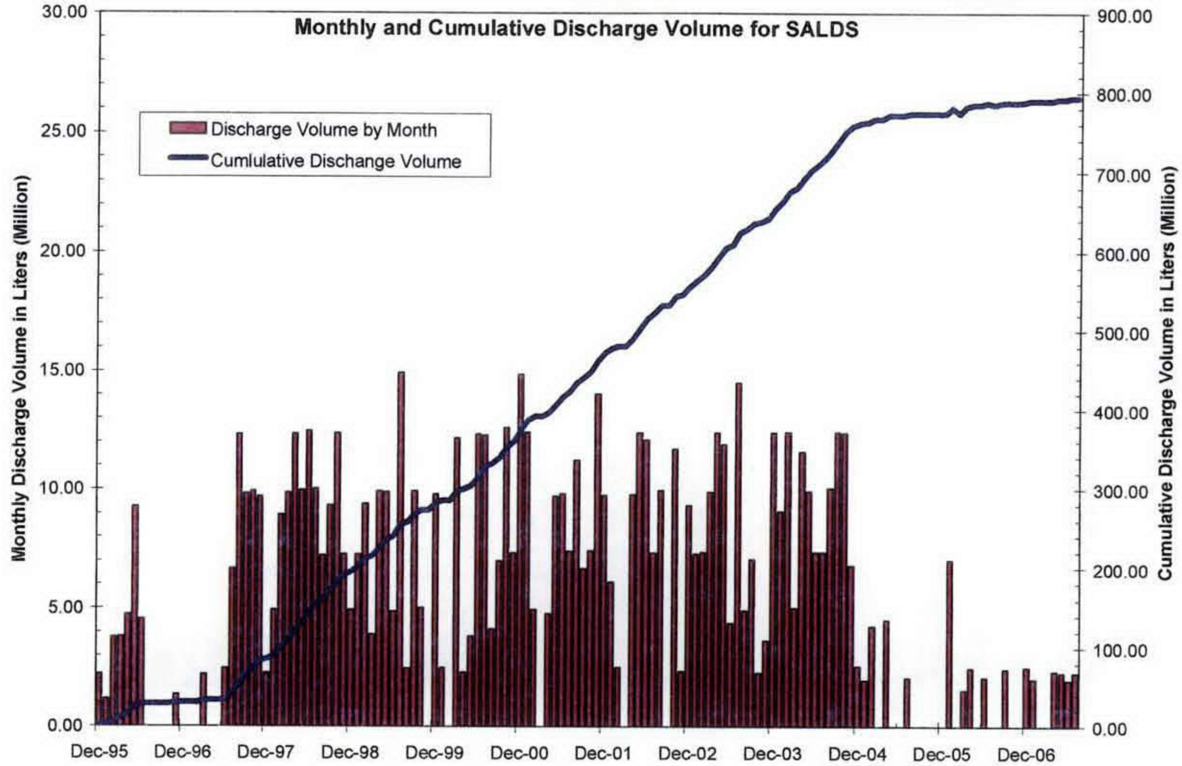
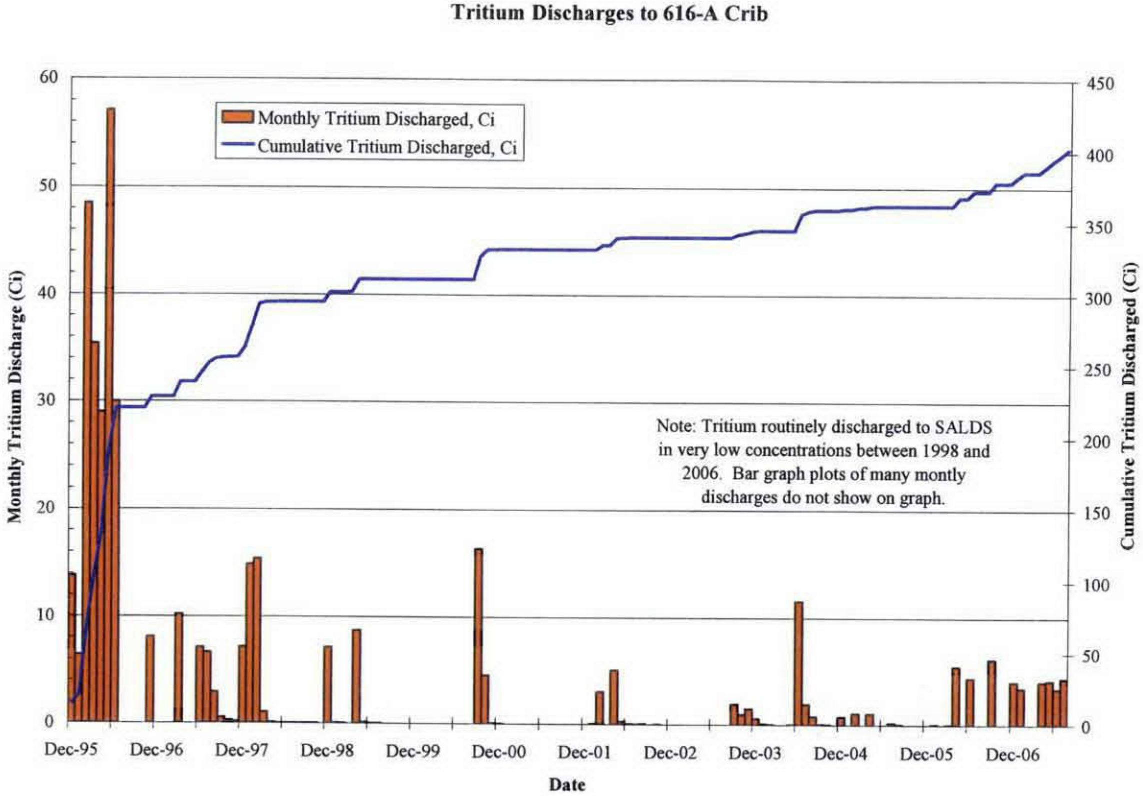


Figure 1-5. Monthly and Cumulative Tritium Mass Discharged to the State-Approved Land Disposal Site Through July 2007.



2.0 RESULTS OF FISCAL YEAR 2007 WATER-LEVEL MEASUREMENTS

Measurements of water levels in wells surrounding the SALDS are necessary for interpretation of local and regional water table elevations and groundwater flow direction. These measurements are used in combination with groundwater chemistry analyses to update conceptual and predictive models to forecast the possible movement of tritium from the SALDS facility.

2.1 SCHEDULE OF WATER-LEVEL MEASUREMENTS

Water levels are measured in all wells prior to each sampling event and have been measured monthly since January 1997 in the proximal SALDS wells (699-48-77A, 699-48-77C, and 699-48-77D). Proximal and tritium-tracking wells are also sampled for other programs, including the LLBG and the 200-ZP-1 Groundwater Operable Unit and Groundwater Interest Area. Therefore, water levels in each well may be measured several times per year.

Water levels have declined in recent years to the point where a number of tritium-tracking wells no longer intersect the groundwater table (see Section 3.1). As this occurs, water-level measurements and sampling in these wells are generally discontinued. At present, five shallow aquifer wells to the south, southwest, and southeast of the SALDS, along with two deep aquifer wells, can be sampled.

2.2 MEASUREMENT RESULTS AND HYDRAULIC HEAD DISTRIBUTION

Current hydrographs (through July 2007) for the SALDS proximal wells and tritium-tracking network are shown in Figures 2-1, 2-2, and 2-3. These wells are grouped by relative position to the SALDS. All of the wells in the 200 West Area have displayed a general water table decline since surface discharges associated with process operations were terminated in 1985 (U Pond) and 1995.

Virtually all water-level readings in active wells were taken in March 2007. The average decline in the water table in the SALDS area between April 2006 and March 2007 was 0.25 m (0.82 ft), as shown in Table 2-1. This normalizes to 0.27 m/yr (0.88 ft/yr), which is somewhat lower than the previous 12 months which averaged at 0.38 m/yr (1.25 ft/yr). The average for the 2 years together is 0.33 m/yr (1.08 ft/yr).

A groundwater mound was not observed in March 2007 beneath the SALDS, and the absence of routine discharges to the facility since January 2005 is thought to be responsible. Since 1997, the hydraulic head at well 699-48-77A has been higher than other surrounding wells as a result of these discharges, but a mound is not distinguishable with the March 2007 data set. This well was placed upgradient from the facility but has exhibited a higher hydraulic head due to movement of the discharge water along the Cold Creek unit (as described in Section 1.2.1). Upgradient wells located southwest of well 699-48-77A and the SALDS can have higher or lower hydraulic heads, depending on the magnitude and timing of discharges to the SALDS. Figure 2-2 shows the trend in water table elevations for wells south and southwest of the SALDS.

When present, groundwater mounding near the SALDS creates a localized downward hydraulic gradient in the aquifer. The head difference between the two shallow wells (699-48-77A and 699-48-77–D) and the deeper well 699-48-77C (Figure 2-1) has dissipated since the cessation of continuous 200-UP-1 pump-and-treat operations. The overall regional hydraulic head has decreased in all of the wells since in 1997.

Historically, deep and shallow tritium-tracking wells 299-W6-6 and 299-W6-7 have not indicated a vertical hydraulic gradient away from the SALDS vicinity (see bottom plot in Figure 2-3). Well 299-W6-7 was completed at the water table, and well 299-W6-6 was completed 51 m (167 ft) deeper in the aquifer. Well 299-W6-7 has gone dry and will no longer be monitored. Well 299-W7-1 was dry in April 2006 and March 2007 due to the declining water level. Both wells 299-W6-7 and 299-W7-5 are dry and have been dropped from the sampling schedule.

The March 2007 water table in the vicinity of the SALDS is shown in Figure 2-4. There is no indication of a groundwater mound beneath the SALDS waste site. Water levels in shallow wells 699-48-77A and 699-48-77D and adjacent monitoring wells do not support the presence of a mound. In the period from March 1997 to March 2005, the SALDS site received an average of 7.98 million L (2.1 million gal) of water per month, which yielded a 0.5- to 1.0-m (1.6- to 3.3-ft)-high mound around the crib. Since March 2005, about 1.15 million L/month (304,700 gal/month) have been discharged to the crib, and a groundwater mound is not suggested by well data.

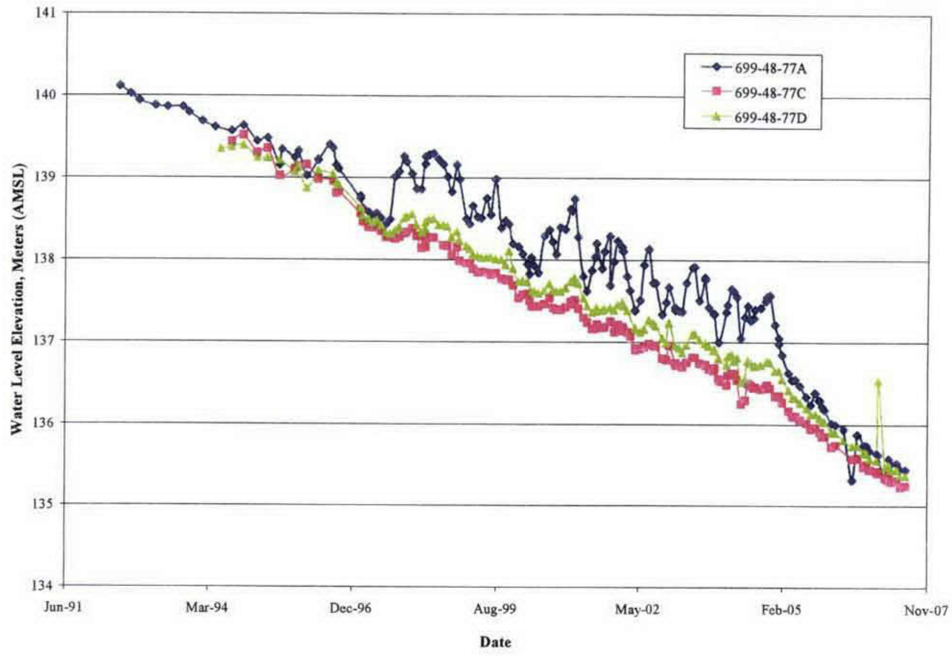
The arrows in Figure 2-4 denoting the interpreted groundwater flow paths indicate that effluent from the SALDS could eventually reach wells located south of the facility. Due to the periodic discharges throughout most of FY07, the lateral spreading occasioned by the infrequent crib discharges is more limited in extent. The distance that effluent travels from the SALDS to the south before turning east is not known but, based on model predictions, is assumed to be restricted. Interpretation of the flow paths (Figure 2-4 and hydrographs in Figures 2-1, 2-2, and 2-3) indicates that wells 699-51-75, 699-51-75P, and 699-48-71 (located 1,000 m [3,280 ft] northeast and 2,000 m [6,560 ft] east, respectively, of the SALDS) are regionally downgradient of the facility and are in a reasonable location for intercepting SALDS effluent. Increasing concentrations of tritium, carbon tetrachloride, and nitrate at well 699-48-71, observed as part of the 200-ZP-1 Operable Unit monitoring (PNNL-16346), suggest a more northerly flow of these contaminants from the south and southwest.

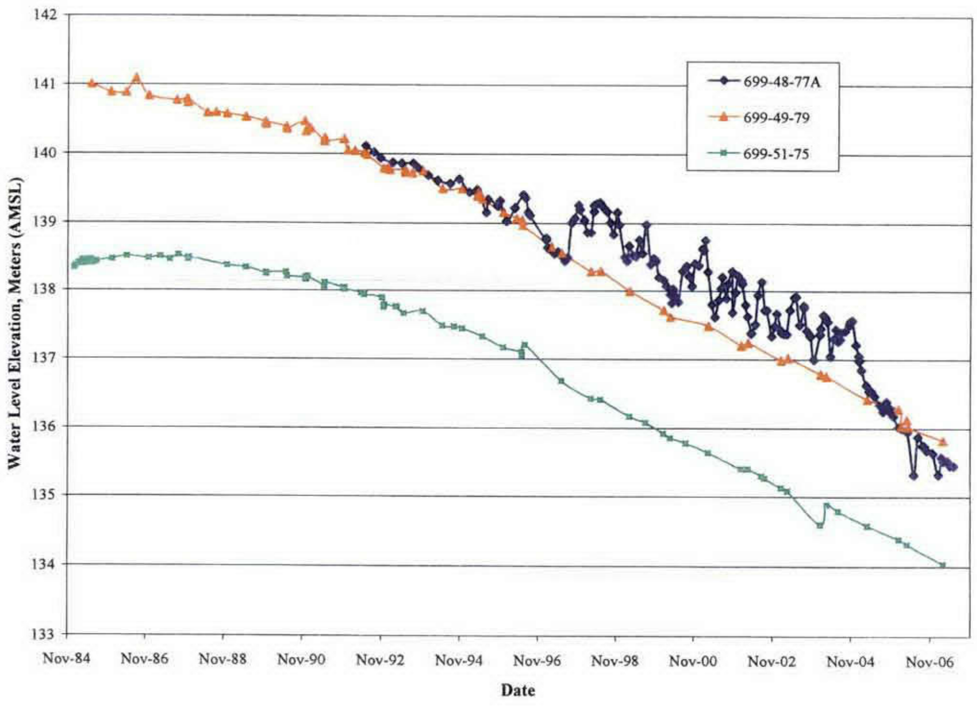
The interpreted flow direction near the SALDS presents a more easterly component for the past few years (in comparison with PNNL-13121), which is a likely result of the continuing regional decline in water levels combined with the SALDS effects. The SALDS crib appears to be close to a divide in flow between groundwater moving around the west end of Gable Butte and toward the 100-B/C Area and groundwater flowing to the east toward the Gable Gap. The general decline in head, as a result of discontinuation of 200 West Area operational discharges to ponds, is evident in Figures 2-1 through 2-3. An overall decline of approximately 6.0 m (19.7 ft) may be expected at the existing wells based on trend data from well 699-49-79; however, agricultural irrigation west of the Hanford Site is expected to prevent groundwater elevations from reaching pre-Hanford levels. The restart of the 200-UP-1 pump-and-treat system, along with the addition of treated groundwater from the 241-T extraction system by the end of FY07, is expected to create a mound in water levels around the crib.

Most of the tritium-tracking wells located south of the SALDS facility were constructed with 6.1-m (20-ft) screens. As shown in Table 2-2, the remaining tritium-tracking wells screened in the upper aquifer will be dry before the year 2015 if the water table continues to decline at the rate of 0.38 m/yr (1.25 ft/yr). Groundwater levels at well 299-W8-1 are suspected of being below the bottom of the well screen in September 2007. Only wells 299-W7-3 and 299-W6-6 (which are screened deeper in the aquifer) would survive past 2015. The head-versus-time plots for wells 299-W7-5 (now dry), 299-W6-11, and 299-W6-12 (Figures 2-5 through 2-7) show the elevation of the screen bottom and support the calculated dry dates for the wells listed in Table 2-2. The head-versus-time plots for proximal monitoring wells 699-48-77A and 699-48-77D are presented in Figures 2-8 and 2-9. Two trend lines have been provided to bracket the range of time during which each well is expected to go dry. With the restart and addition of pump-and-treat water from the 200-UP-1 and the 241-T wells, well 699-48-77A is expected to remain active for the next 3 to 5 years. After that, or with cessation of pump-and-treat activities at the ETF, a replacement well may be needed. The head-versus-time plot for groundwater monitoring well 699-48-77D is presented in Figure 2-10.

The wells are expected to be "sample-dry" several years before they are totally dry. The plot for well 299-W7-5, which was reported sample-dry in 2004, shows that water levels were obtained in April 2006. However, the absence of FY07 water level data indicates that the aquifer had dropped below the bottom elevation of the screen.

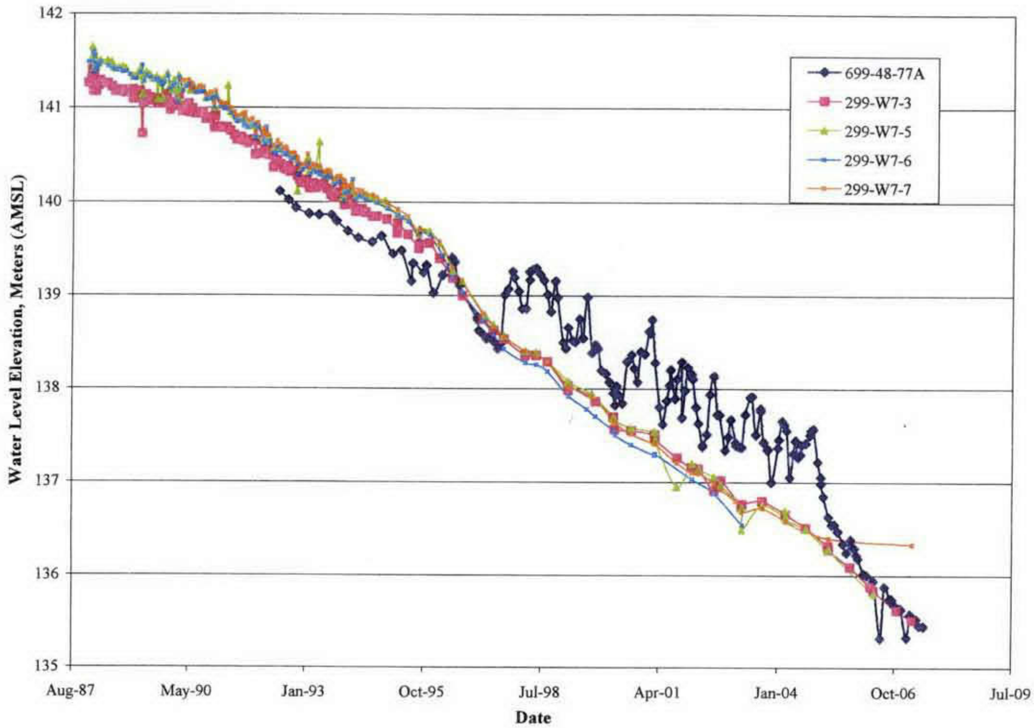
Figure 2-1. Hydrographs of State-Approved Land Disposal Site Proximal Wells (top) and Tritium-Tracking Wells North, Northwest, and East of the Site (bottom) Compared with Well 699-48-77A.





NOTE: Well 699-48-77C is completed (screened) approximately 20 m (65.6 ft) deeper within the aquifer than the other two proximal wells.

Figure 2-2. Hydrographs of Tritium-Monitoring Wells South (top) and Southwest (bottom) of the State-Approved Land Disposal Site Compared with Well 699-48-77A.



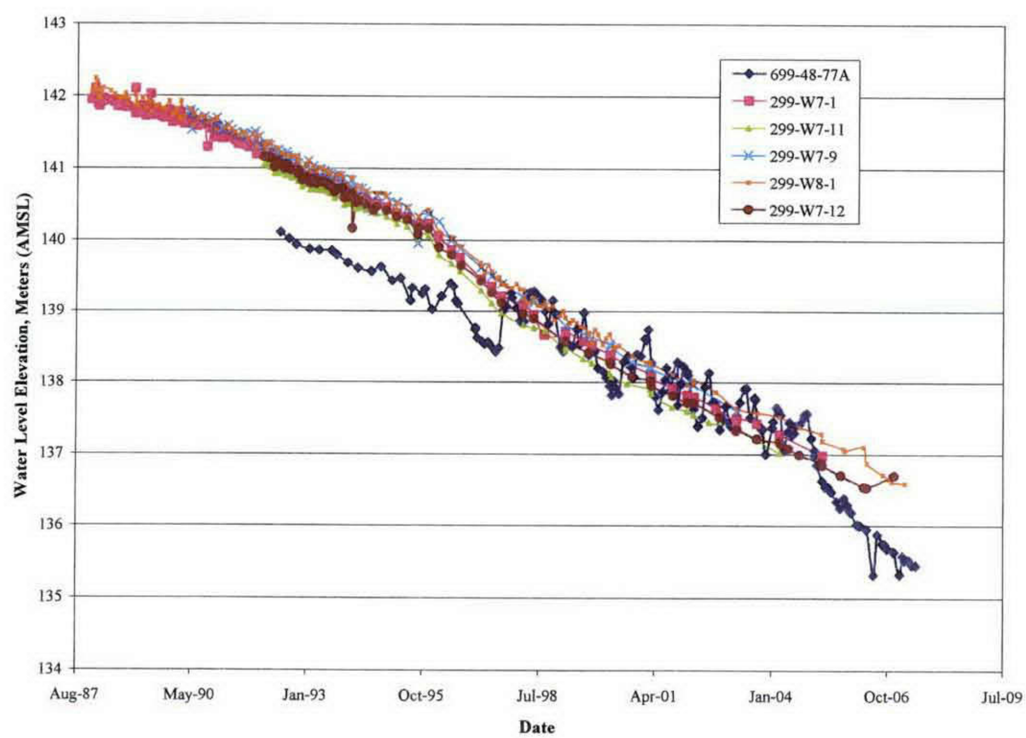
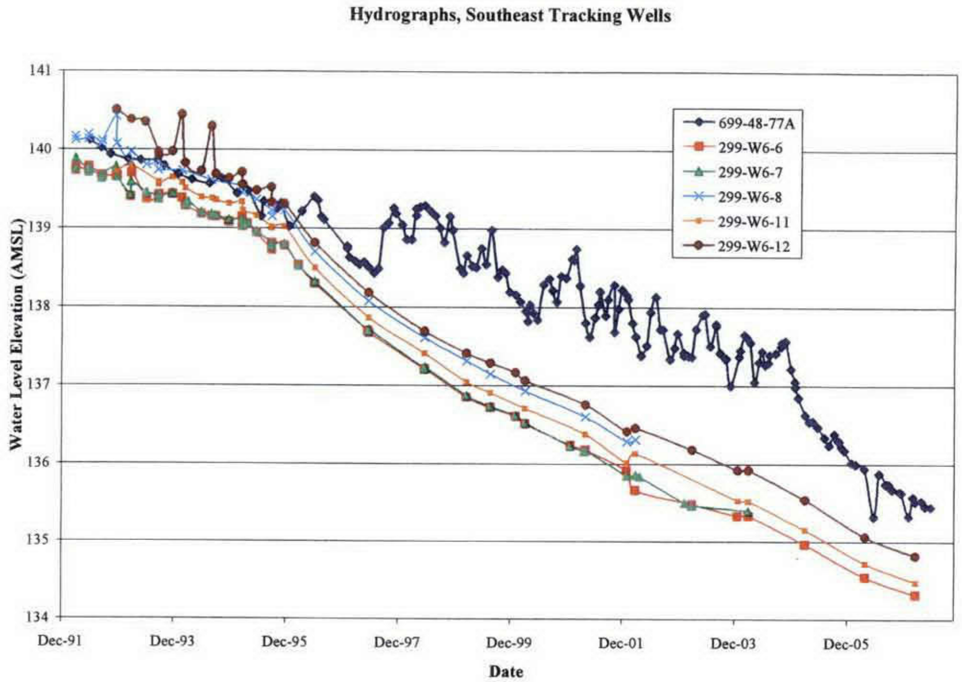
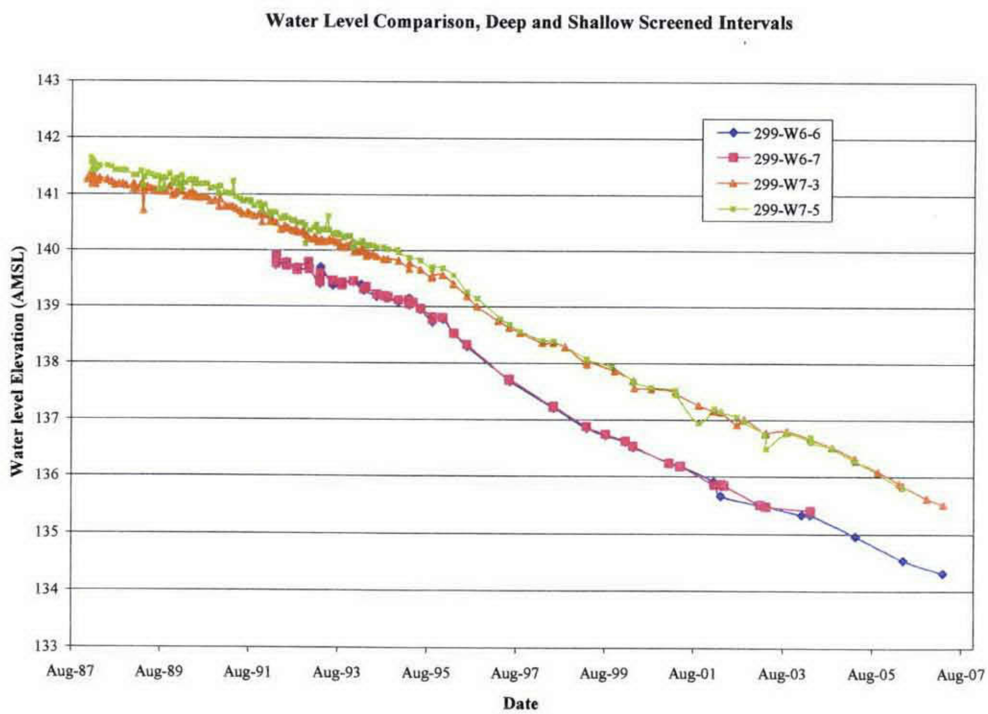


Figure 2-3. Hydrographs of Tritium-Monitoring Wells Southeast of the State-Approved Land Disposal Site Compared with Well 699-48-77A (top) and Deep/Shallow Companion Wells (bottom).





Note: Well 299-W6-6 is completed approximately 51 m (167 ft) deeper in the aquifer than well 299-W6-7.

Figure 2-4. Water-Table Map and Interpreted Groundwater Flow Directions in the State-Approved Land Disposal Area for April 2006.

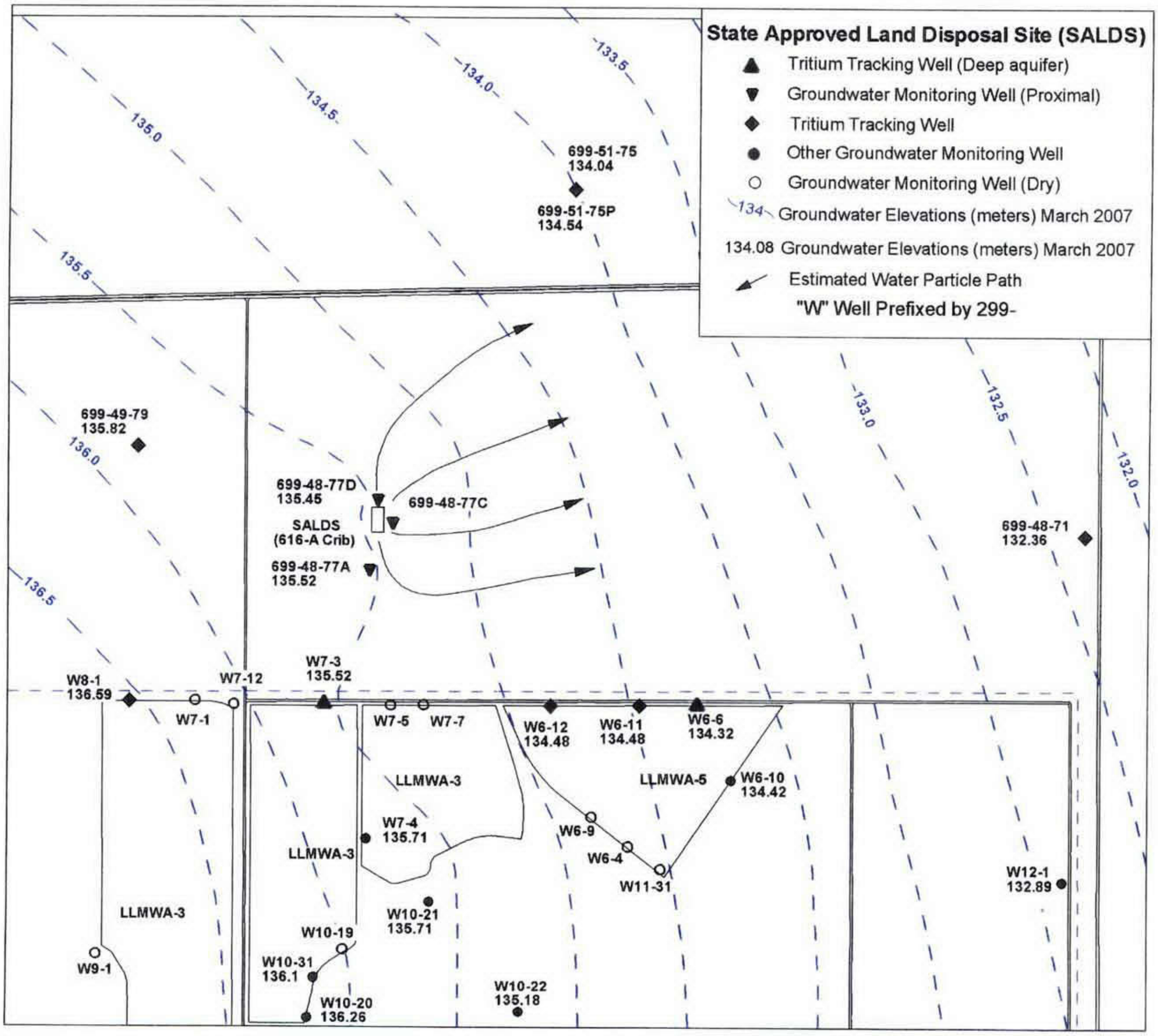


Figure 2-5. Tritium-Tracking Well 299-W7-5, Head Versus Screen.

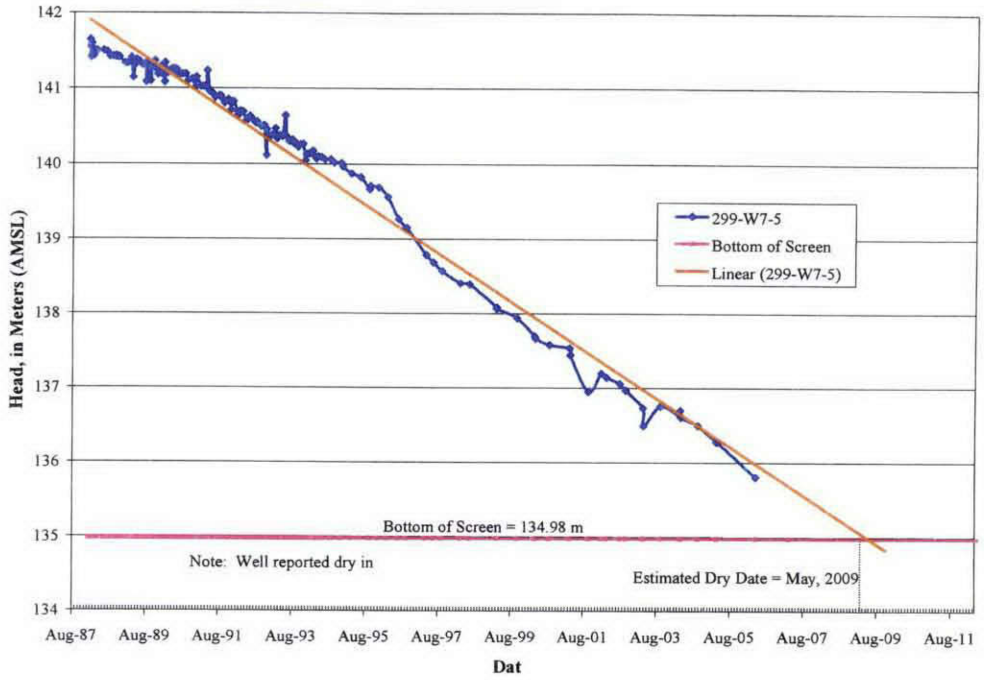


Figure 2-6. Tritium-Tracking Well 299-W6-11, Head Versus Screen.

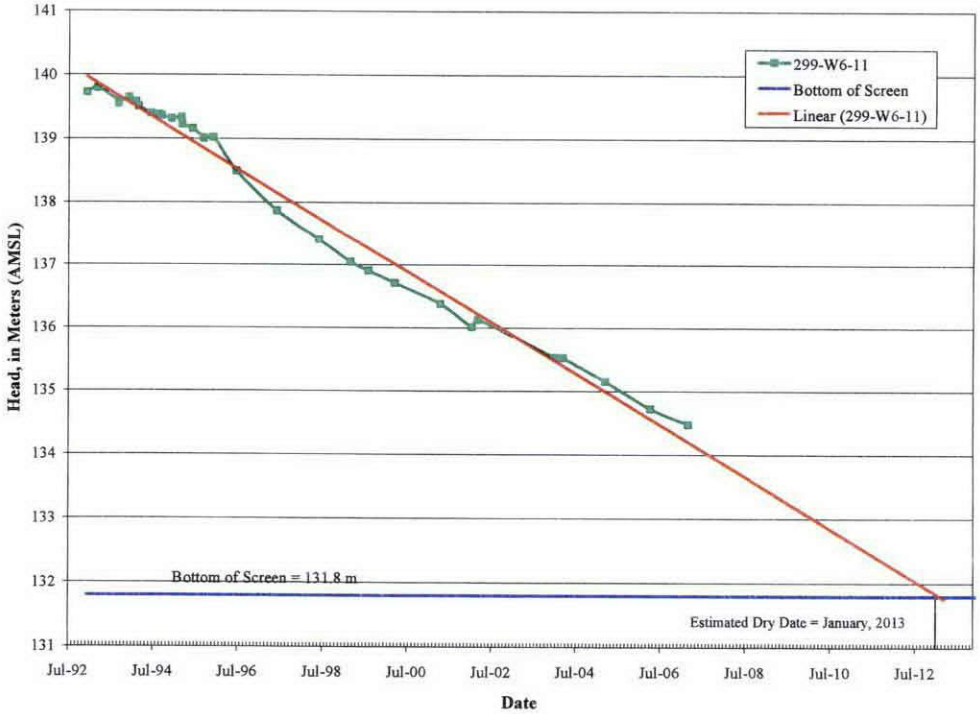


Figure 2-7. Tritium-Tracking Well 299-W6-12, Head Versus Screen.

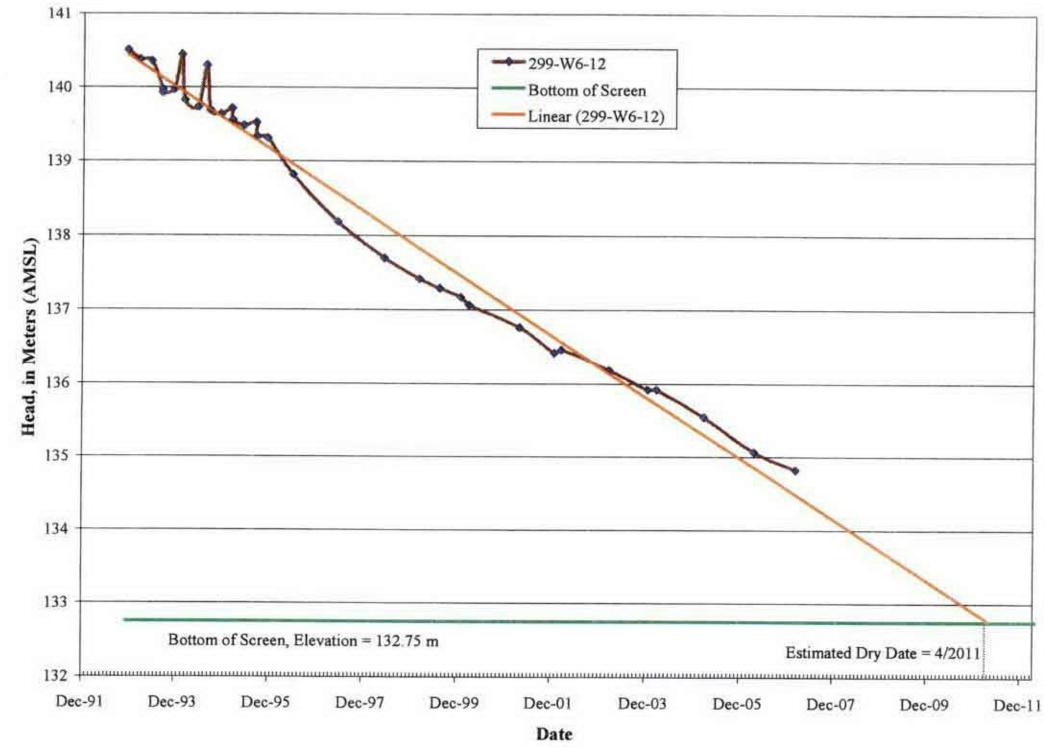


Figure 2-8. Tritium-Tracking Well 299-W7-7, Head Versus Screen.

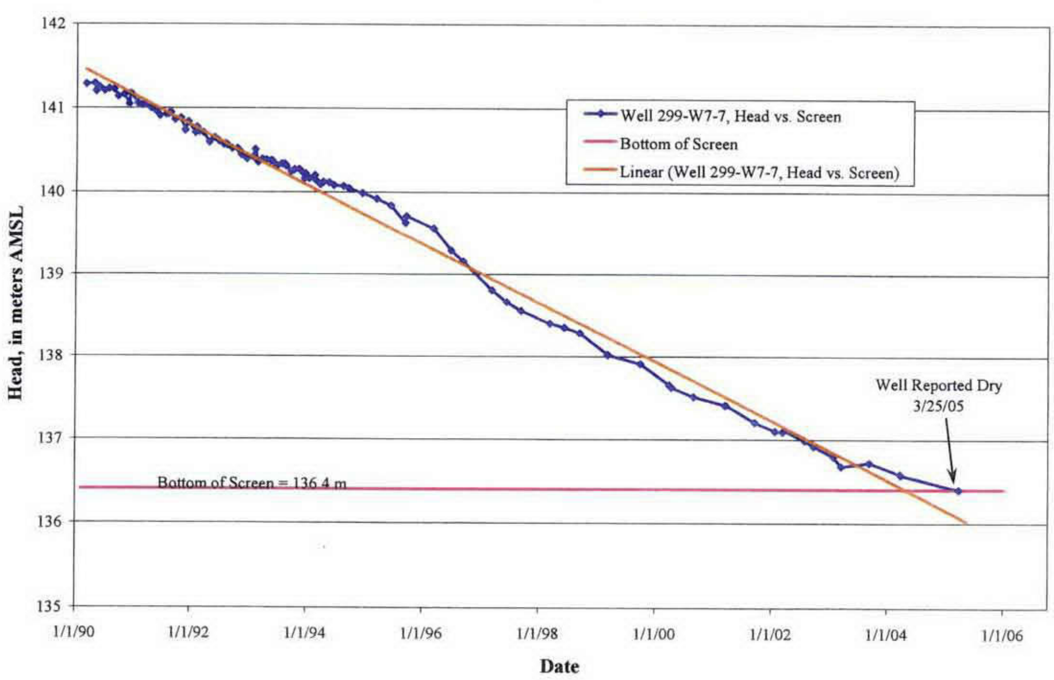


Figure 2-9. Groundwater Monitoring Well 699-48-77A, Head Versus Screen.

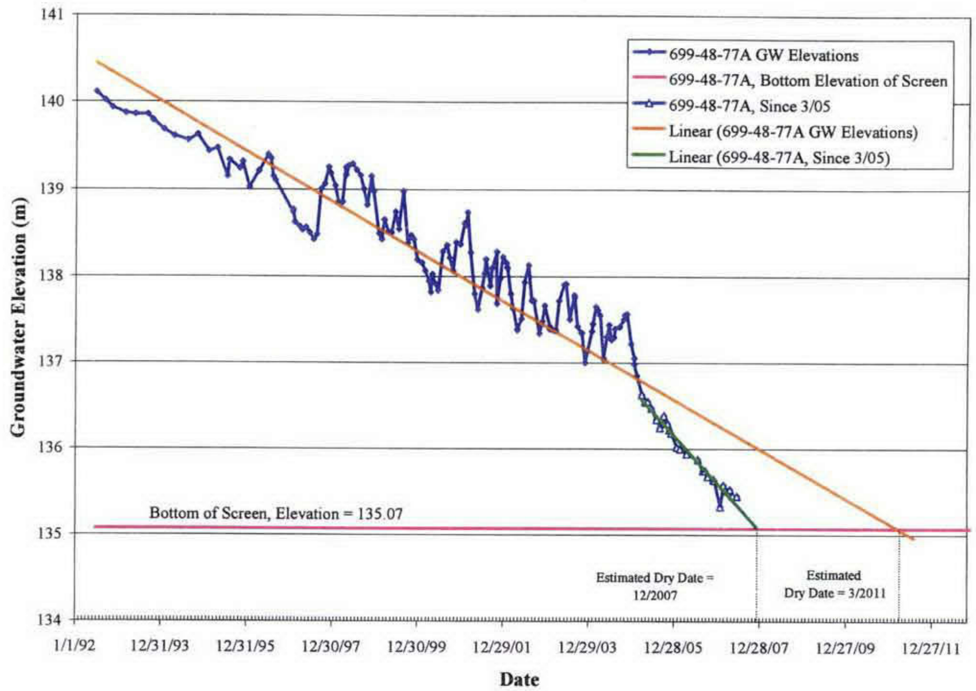


Figure 2-10. Groundwater Monitoring Well 699-48-77D, Head Versus Screen.

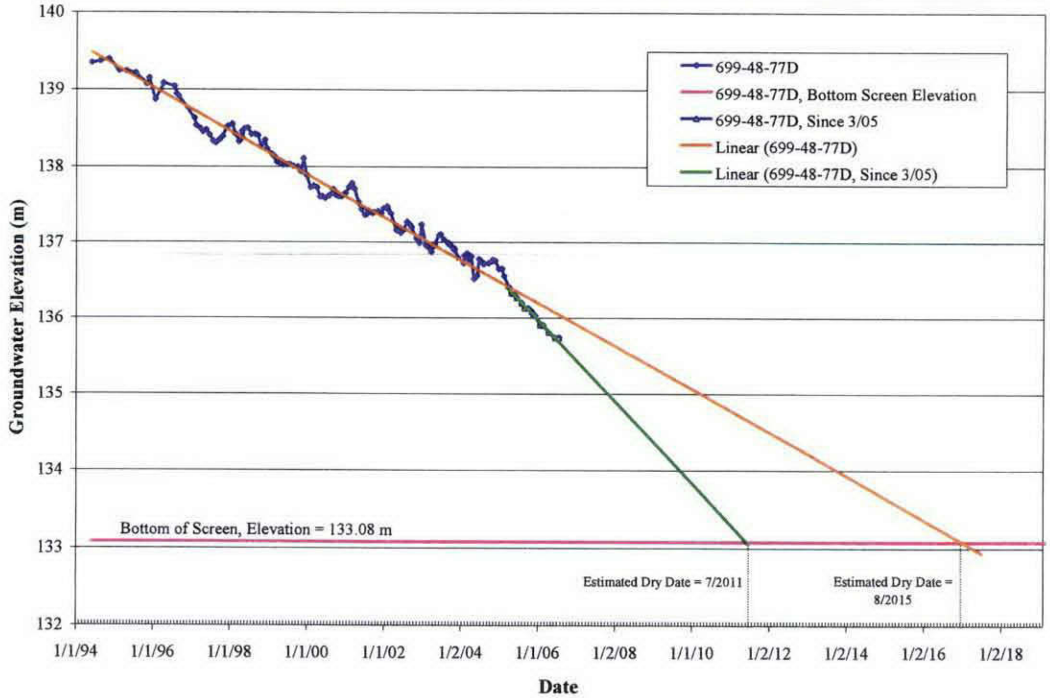


Table 2-1. Change in Water Table Elevation (in meters), April 2006 Versus March 2007.

Well	April 2006	March 2007	Change from 2006 to 2007
699-48-77A	135.94	135.52	-0.42
699-48-77D	135.81	135.30	-0.51
699-49-79	136.08	135.82	-0.26
299-W8-1	136.87	136.59	-0.28
299-W7-12	136.54	136.70	+0.16
299-W7-5	135.80	--	--
299-W7-4	136.05	135.71	-0.34
299-W10-21	135.83	135.71	-0.12
299-W10-20	136.57	136.26	-0.31
299-W7-7	136.40	136.33	-0.07
299-W10-22	135.54	135.18	-0.36
299-W6-12	135.07	134.82	-0.25
299-W6-11	134.72	134.48	-0.24
299-W6-10	134.52	--	--
299-W12-1	133.11	132.89	-0.22
699-48-71	132.61	132.36	-0.25
699-51-75	134.32	134.04	-0.28
11-month average	--	--	**-0.25**
12-month average	--	--	**-0.27**

Table 2-2. Calculated Dry Dates for Remaining Tritium Monitoring Wells at and South of the State-Approved Land Disposal Site.

Well	Surface Elevation (Z in HWIS) (m)	Depth to Screen Bottom/Elevation (m)	March 2007 Water Table Elevation (m)	Saturated Screens Thickness (m)	Saturated Screen Divided by 0.27 m/yr = Years Until Well Is Dry	Calculated Dry Well Date
299-W7-12	208.678	73.08 / 135.6	136.70	136.70 – 135.6 = 0.91	1.1 ÷ 0.27 = 4.1	4.1 years = 2011
299-W7-1	210.968	74.7 / 136.27	--	0	0	Dry in 2006 (sample-dry in 2004)
299-W7-3	206.45	143.29 / 63.13	135.52	135.52 - 63.13 = 72.71	72.71 ÷ 0.27 = 268[a]	--
299-W7-5	205.437	69.73 / 135.7	--	0	0	Dry in 2007 (sample-dry in 2005)
299-W7-7	205.90	69.45 / 136.45	--	0	0	Dry in 2006 (sample-dry in 2004)
299-W7-6	207.219	73.48 / 133.74	--	0	0	Dry in 2006 (sample-dry in 2003)
299-W6-6	215.439	130.88 / 84.56	134.32	134.32 - 84.56 = 49.76	49.76 ÷ 0.27 =184[a]	--
299-W6-12	211.091	78.47 / 132.75	134.82	2.07	2.07 ÷ 0.27 = 7.7	2014
299-W6-11	214.388	76.49 / 131.8	134.48	2.68	2.92 ÷ 0.27 = 10	2017
299-W8-1	214.29	78.14 / 136.59	136.59	0	0	Dry in 2007.
299-W7-11	206.664	70.64 / 136.02	--	0	0	Dry in 2006 (sample-dry in 2002)
699-48-77A	205.922	70.85 / 135.07	135.52	135.52 - 135.07 = 0.45	0.45 ÷ 0.27 = 1.7	2009
699-48-77D	204.634	71.55 / 133.08	135.45	135.45 - 133.08 = 2.37	2.37 ÷ 0.27 = 8.80	2016

[a] Calculation invalid; water-level decline is not expected to exceed approximately 6 m (20 ft) in the foreseeable future.
HWIS = Hanford Well Information System

3.0 RESULTS OF FISCAL YEAR 2007 GROUNDWATER ANALYSES FOR THE STATE-APPROVED LAND DISPOSAL SITE

Groundwater is analyzed quarterly for tritium in the SALDS proximal wells (699-48-77A, 699-48-77C, and 699-48-77D) and annually to semi-annually in the tritium-tracking wells located in the vicinity of the facility (Table 3-1). Tritium results from FY07 are discussed in Section 3.2 and are listed in Appendix A. Tritium samples for the Pacific Northwest National Laboratory's Sitewide monitoring program are taken annually at these wells.

In addition to tritium, groundwater from the proximal wells is analyzed for a list of 15 constituents, as required by *State Waste Discharge Permit Number ST-4500*, Special Condition S1(A) (Ecology 2000). Enforcement limits were set for most of these constituents, which included acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), pH, sulfate, tetrahydrofuran, and total dissolved solids. Gross alpha, gross beta, strontium-90, and tritium are not assigned enforcement limits but are monitored and reported for informational purposes. Analytical results for all of the parameters required by the Permit are also reported quarterly in discharge monitoring reports. Additional parameters (e.g., alkalinity, dissolved oxygen, temperature, and turbidity) are sought for determination of general groundwater characteristics and for verifying the quality of analytical results. Maximum concentrations for these constituents and the corresponding sample months for FY07 are discussed below and are listed in Table 3-2.

3.1 GROUNDWATER SAMPLING AND ANALYSIS FOR FISCAL YEAR 2007

Samples for the three proximal wells were collected in October 2006, as well as in January/February, April, and July 2007. Tritium-tracking wells are sampled on an annual or semi-annual basis for tritium only. The tritium-tracking wells were sampled in January through May 2007. Some of the tritium-tracking wells are also sampled for a broader range of constituents for the LLBG facility and Sitewide groundwater surveillance program. The tritium results from these programs, in addition to those collected specifically for the SALDS, are included in Appendix A.

Declining regional water levels are causing shallow wells in the SALDS tritium-tracking network along the northern perimeter of LLWMA-3/5 to go dry. As of July 2007, 10 wells in the original SALDS tritium-tracking network are sample-dry (Table 3-1). Of the five active wells along the northern perimeter of LLBG-3/5, two wells are screened deeper in the aquifer. Well 299-W7-5 became dry in 2006, and sampling was not successful in 2007. Water levels were not obtained at this well. A total of 11 wells are still used for tritium tracking or water-level measurements.

Wells 699-51-75, 699-48-71, and 699-49-79 are older wells that are sampled with dedicated submersible electric pumps. Well 699-51-75P is a piezometer nested within well 699-51-75 but is completed 41 m (135 ft) deeper in the aquifer and is sampled with an airlift hose. This method is acceptable when sampling for tritium only. All other wells are sampled using dedicated pumps.

3.2 RESULTS OF TRITIUM ANALYSES (TRITIUM TRACKING)

Groundwater in the three proximal wells has been affected by tritium discharges since 1996. Figure 3-1 shows tritium activities in the proximal wells since groundwater monitoring began at the SALDS. Results of the tritium analyses for the tritium-tracking well network for FY07 are presented as trend plots in Figure 3-2. Individual and average 2007 values are listed in Appendix A. Figure 3-3 shows the entire network, average tritium values at each well, and whether concentrations increased, decreased, or remained unchanged from last year.

3.2.1 Proximal Wells

Tritium activities declined in two of three proximal wells in FY07 compared to FY06 (Figure 3-1 and Figure 3-3). The maximum tritium concentrations in these wells and the dates that the wells were sampled in FY06 are as follows:

- Well 699-48-77A: 56,000 pCi/L (in July 2007)
- Well 699-48-77C: 82,000 pCi/L (in October 2006)
- Well 699-48-77D: 130,000 pCi/L (in April and July 2007).

Figure 3-1 shows that peak tritium concentrations occurred in September 1997 (2,100,000 pCi/L) and February 1998 (2,100,000 pCi/L) in wells 699-48-77A and 699-48-77D, respectively. The peak concentration in well 699-48-77C (980,000 pCi/L) was delayed until February 2001, probably because this well is screened approximately 20 m (65.6 ft) deeper in the aquifer and it took longer for the plume front to migrate to this depth. Additionally, tritium incursions to deeper well 699-48-77C have been lower in magnitude, and cyclical variations are also absent. These differences are attributed to the deeper screen setting and the dilution and attenuation of the plume as it moves vertically through the aquifer.

Since the time of peak concentrations in these wells, the trends have been generally downward. However, changes in well 699-48-77A are irregular (Figure 3-1) with what appears to be roughly annual highs and lows of significant amplitude (sometimes two order-of-magnitude changes) in 3 of the last 4 years. These fluctuations likely reflect the annual campaigns of the 242-A evaporator wastewater, which is high in tritium. Similar fluctuations are expected in the future due to intermittent campaigns of K Basins Project wastewater, which is also high in tritium.

Well 699-48-77D is located nearest to the SALDS, yet showed a tritium incursion starting in September 1997, more than one year later than more distant well 699-48-77A. The reason for this delay is two-fold: (1) the SALDS drain field fills from the southern end of the facility furthest away from well 699-48-77D, and (2) discharged water initially moves to the south due to effects of the Cold Creek unit beneath the SALDS (see Section 1.2.1). These two conditions direct the subsurface flow of effluent away from well 699-48-77D so it actually reaches the groundwater nearer to well 699-48-77A. Some hint of a quasi-annual fluctuation is suggested by the curve for well 699-48-77D, but the amplitude is significantly less than compared to well 699-48-77A.

Well 699-48-77C is screened approximately 20 m (65.6 ft) deeper in the aquifer than wells 699-48-77A and 699-48-77D and did not show peak tritium activity of 980,000 pCi/L until February 2001. Because of the well's deeper position in the aquifer, tritium incursions from SALDS operation have been historically lower at this well. During times of high discharge, the hydraulic head beneath the SALDS increases and effluent is forced deeper into the aquifer, more readily affecting well 699-48-77C.

The current tritium trends at the three wells are mixed. Well 699-48-77A appears to be slowly increasing in FY07 above the FY06 trend, while well 699-48-77C continues to slowly decline. Well 699-48-77D has been increasing over the last 2 years, to the April and July 2007 concentrations of 130,000 pCi/L, or a three-fold increase from the May 2005 concentration of 37,000 pCi/L. This may represent the delayed response to the 280,000 pCi/L peak experienced at well 699-48-77A in January 2005 but is more delayed than past responses to peaks at well 699-48-77A. In addition to the discussion above, this change may be due to reductions and shifts in overall groundwater direction flow.

3.2.2 Tritium Plume-Monitoring Wells

Tritium activities were also generally unchanged in the tritium-tracking wells (Figure 3-2). Data for the tritium wells are listed in Appendix A. Wells located southeast of the SALDS have exhibited elevated activities of tritium as a result of historical disposal practices in the 200 West Area. Tritium activities in well 299-W6-11 have slowly decreased over the past several years (Figure 3-2, bottom graph). Well 299-W6-7 became dry in 2003, but tritium concentrations had declined steadily from over 40,000 pCi/L in 1993 to about 10,000 pCi/L in 2002.

Well 699-W6-11, the easternmost of the remaining tritium monitoring wells, has had slowly declining tritium concentrations just below 5,000 pCi/L since 2001. The maximum tritium concentrations (47,000 pCi/L) occurred in 1995, prior to the start of SALDS operations. The 2007 tritium concentration in well 299-W6-11 was 3,290 pCi/L, which is down 17% from 3,950 pCi/L in 2006.

Tritium was also trending slightly downward in 2007 in well 299-W6-12 (Figure 3-2, top graph), located just west of well 299-W6-11. Tritium decreased from 297 pCi/L in 2006 to 263 pCi/L in 2007. Previously, tritium concentrations have been nearly 600 pCi/L in this well; however, the source is believed to be an older tritium plume originating within the 200 West Area.

No water samples for analysis were obtained at well 299-W7-5 in FY07. No other shallow aquifer wells are available south and southwest of the SALDS to detect tritium in the shallow aquifer. The FY05 concentration was 46.3 pCi/L (Figure 3-2, top graph), which is near the detection limit for tritium; however, tritium in this well ranged to a maximum of 860 pCi/L in July 2002. Figure 3-2 shows that tritium was present prior to operation of the SALDS in 1995; therefore, tritium at this well also originates from a pre-existing plume in the 200 West Area. Numerical modeling, however, implies that tritium from the SALDS could eventually reach this well location after the well has gone dry. Another well, 299-W8-1 (located to the west of well 299-W7-5), has rarely detected tritium in concentrations above the 25 pCi/L detection limit.

3.3 RESULTS OF OTHER CONSTITUENT ANALYSES

Groundwater from the proximal wells is analyzed for a list of 15 constituents (including tritium) required by the *State Waste Discharge Permit Number ST-4500*, Special Condition S1(A) (Ecology 2000). Permit limits are set for most of the following constituents: acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), pH, sulfate, tetrahydrofuran, and total dissolved solids. There are no assigned limits for gross alpha, gross beta, strontium-90, and tritium, but these constituents are monitored and the concentrations are reported. Additional parameters (e.g., alkalinity, dissolved oxygen, temperature, and turbidity) are monitored for determination of general groundwater characteristics and for verifying the quality of analytical results. Maximum concentrations for these constituents and the corresponding sample months for FY07 are listed in Table 3-2.

All 11 constituents with ST-4500 Permit limits were below Permit limits in the proximal wells during FY07.[1] Acetone, benzene, cadmium, chloroform, and tetrahydrofuran were reported below detection limits in all three wells for all of the samples collected during FY07. Three target metals (i.e., lead, mercury, cadmium, and copper) were found at near-detection concentrations in one or more of the proximal wells. At well 699-48-77A, maximum concentrations of copper, lead, and mercury were present at 3.23 µg/L, 1.69 µg/L, and 0.07 µg/L, respectively, among the proximal wells. This concentration of contaminants is attributed to the relatively rapid migration of discharges to the groundwater near this well.

Laboratory and field pH measurements were within the 6.5 to 8.5 criterion in all samples collected from proximal wells during FY07. This criterion was also satisfied in 2005 and 2006.

Gross-alpha concentrations were 2.3 and 2.1 pCi/L in January 2007 samples from wells 699-48-77C and 699-48-77D. Gross-beta values ranged between 2.2 and 4.7 pCi/L at the three wells, with one outlier value of 15 pCi/L reported at well 699-48-77C in October 2006. There are no Permit limits associated with gross alpha or gross beta. Strontium-90 was detected only at proximal well 699-48-77D (1.8 pCi/L) in FY07. At wells 699-48-77A and 699-48-77C, strontium-90 concentrations were below detection limits.

Several anions and metals increased in concentration after startup of the SALDS. As previously discussed, this was likely due to transport of dissolved soluble mineral species in the vadose zone during percolation of SALDS effluents (PNNL-11633, PNNL-11665). The specific conductance of well 699-48-77A, a measure of total ions in solution, clearly shows a definite spike in the months after the SALDS discharge began in December 1995 (Figure 3-4). A spike to 367,000 µg/L total dissolved solids, observed in the July 2006 sample at well 699-48-77A, was determined to be an outlier value. The reanalyzed sample value of 117,000 µg/L is used for this sampling event. Overall, the concentrations of total dissolved solids and specific conductance observed over the past few years appear to be slowly increasing in FY07.

Since well 699-48-77C is screened approximately 20 m (65.6 ft) below the water table, the vertical downward component of groundwater movement is due to mounded water. Thus, chemical contaminants in SALDS discharges are significantly delayed and subdued in the deeper well with respect to the two shallow wells. The peak concentrations of conductivity and total dissolved solids are also shown in Figures 3-4 and 3-5, respectively. These occurred in late 1999 to early 2000, approximately 3 years later than in wells 699-48-77A and 699-48-77D. Specific conductance values have increased at well 699-48-77D since cessation of 200-UP-1 Pump-and-Treat discharges to SALDS, but continue to gradually decrease at well 699-48-77C. Total dissolved solids trends at these two wells are highly variable and do not show specific trends.

Similar delayed behavior is seen in Figures 3-6 and 3-7 for chloride, sulfate, calcium, and sodium in the proximal wells. For example, the initial increase in sulfate concentration in wells 699-48-77A and 699-48-77D in December 1995 occurred within 6 months after the start of disposal to the SALDS. Sulfate concentrations did not increase in well 699-48-77C until late 1998, or 3 years after the start of disposal. For the above analytes, since 2005, concentrations are increasing at well 699-48-77D. At wells 699-48-77A and 699-48-77C, the concentrations are slowly declining or are stable.

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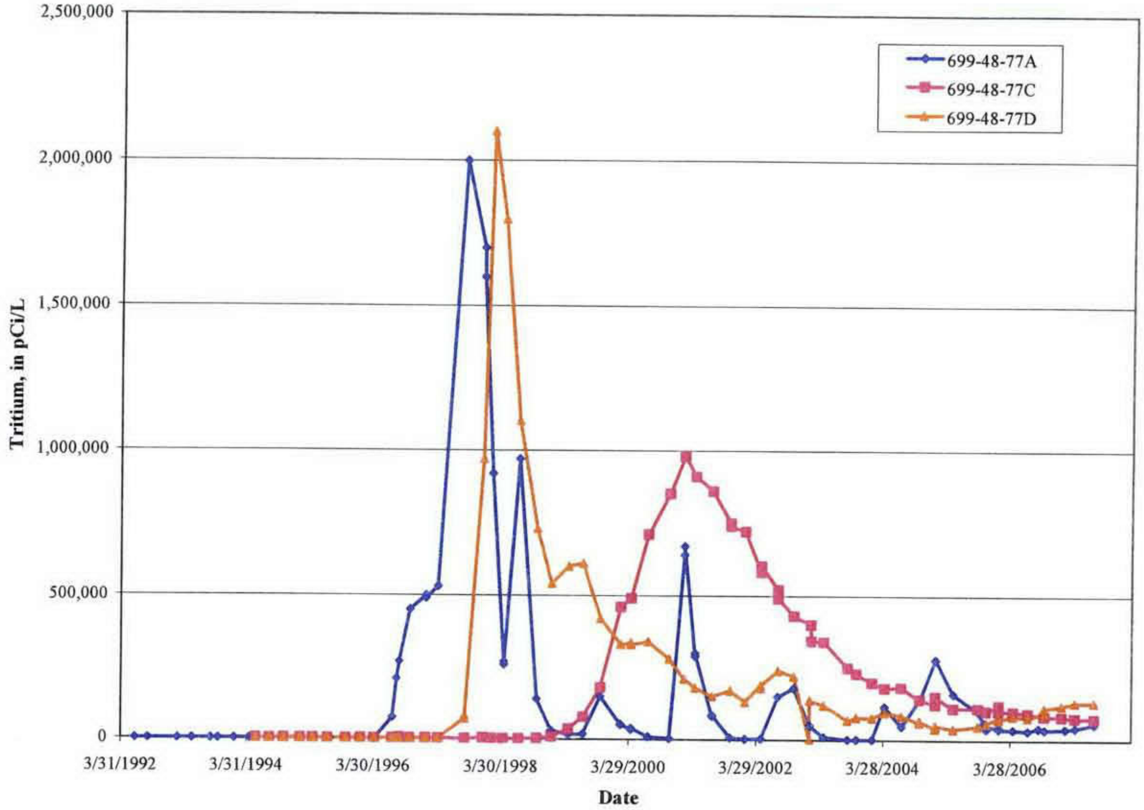
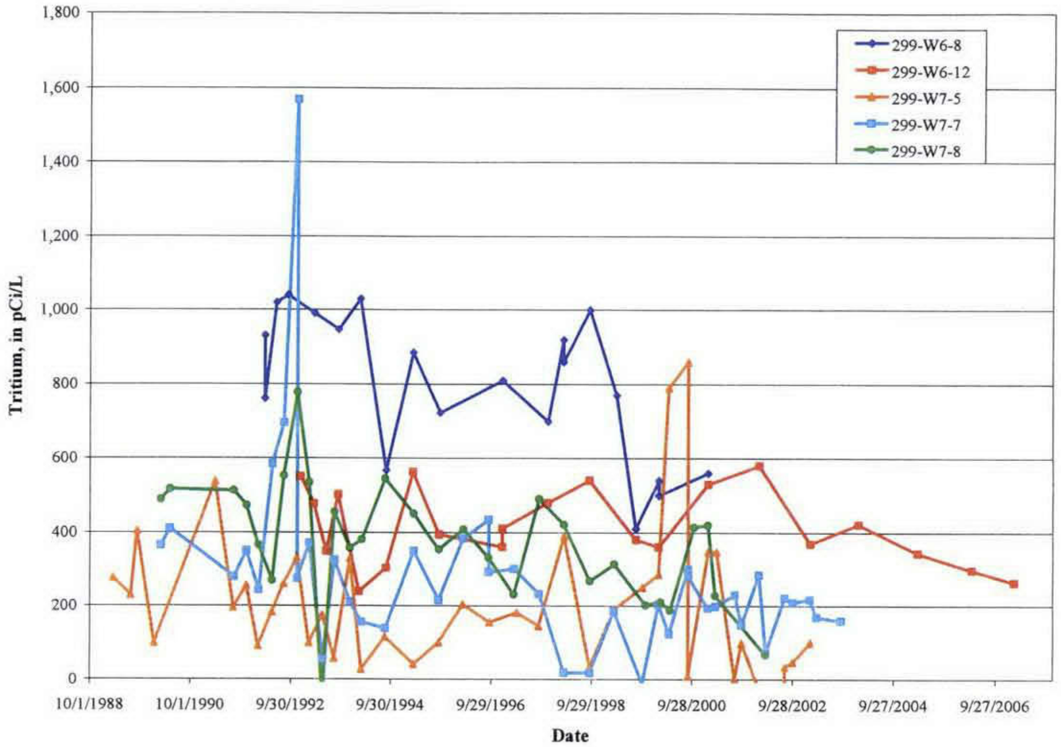
[1] Period reported is October 1, 2006, through July 30, 2007.

Figure 3-1. Tritium Activity Trends in State-Approved Land Disposal Site Proximal Wells Through July 2007.



NOTE: Well 699-48-77C is completed approximately 20 m (65.6 ft) deeper in the aquifer than wells 699-48-77A and 699-48-77D.

Figure 3-2. Tritium Activity Trends in Wells Southeast of the State-Approved Land Disposal Site Showing Remnant Effects of the Tritium Plume from the 200 West Area.



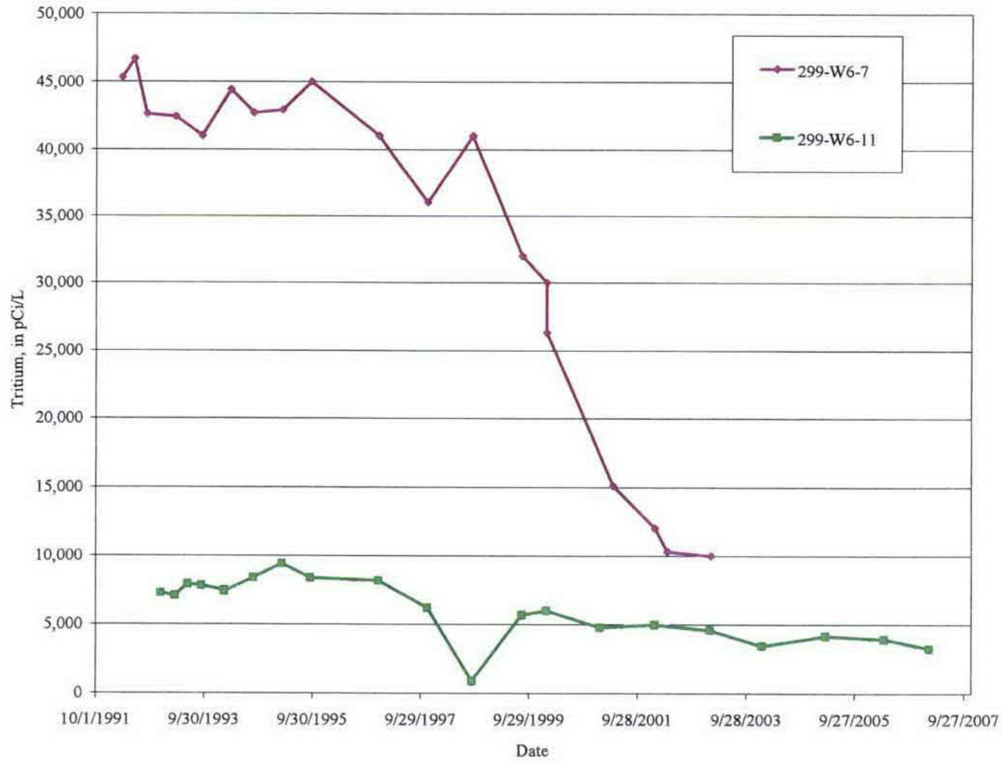


Figure 3-3. Average Tritium Activities in Groundwater for State-Approved Land Disposal Site Tritium-Tracking Network for Fiscal Year 2007 (Indicating Change from Average Fiscal Year 2006 Results).

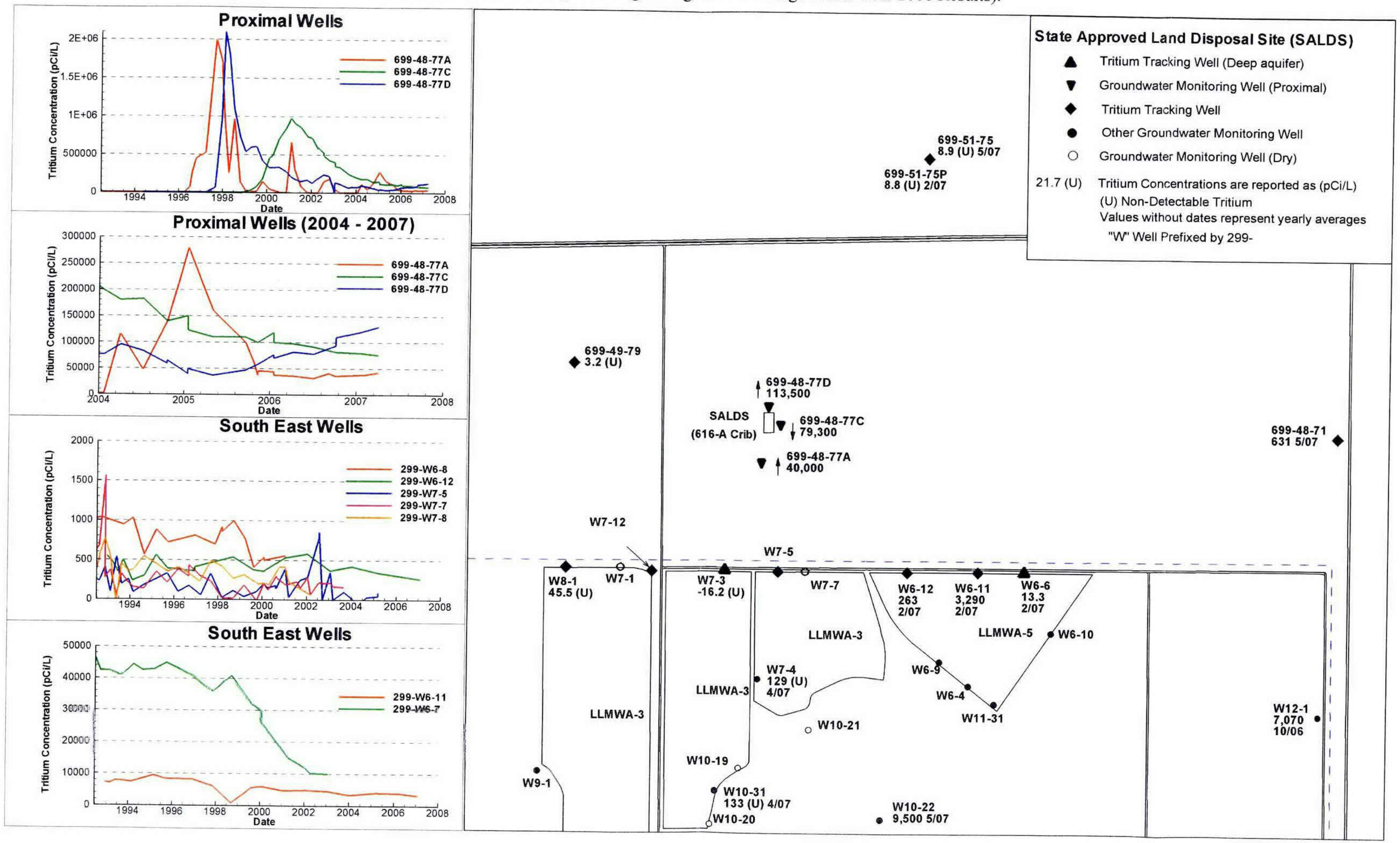


Figure 3-4. Trend Plots for Conductivity in State-Approved Land Disposal Site Proximal Wells.

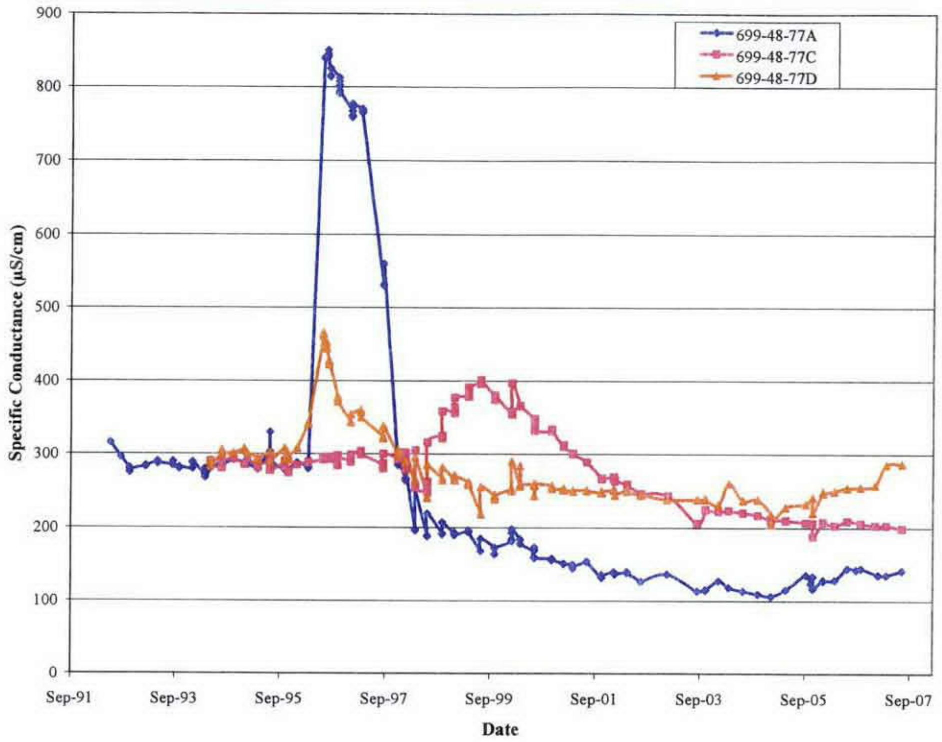


Figure 3-5. Trend Plots for Total Dissolved Solids in State-Approved Land Disposal Site Proximal Wells.

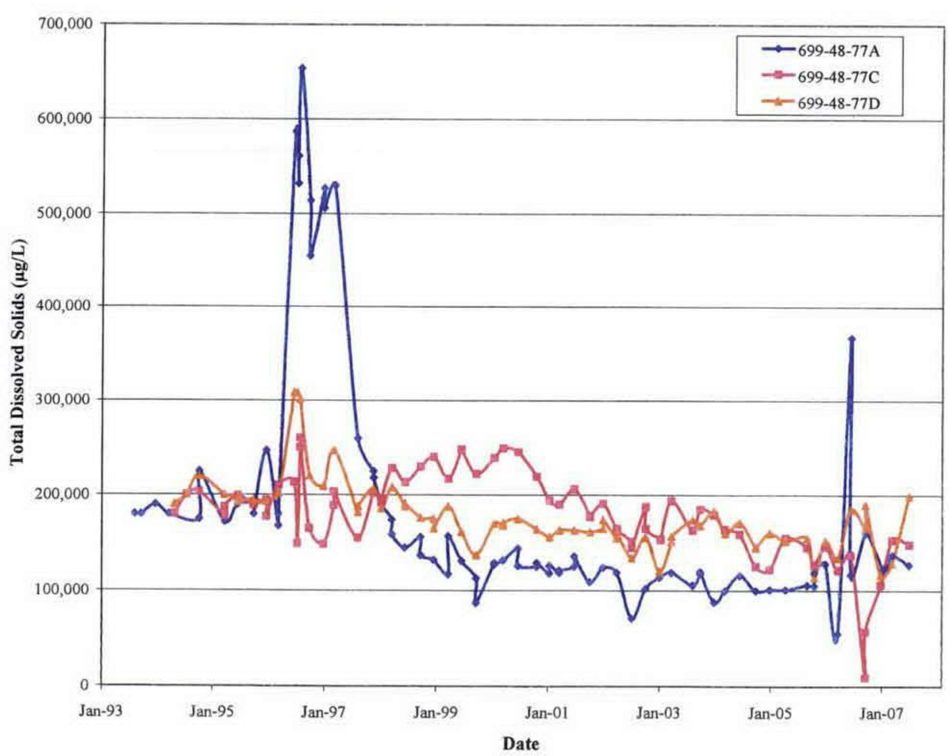
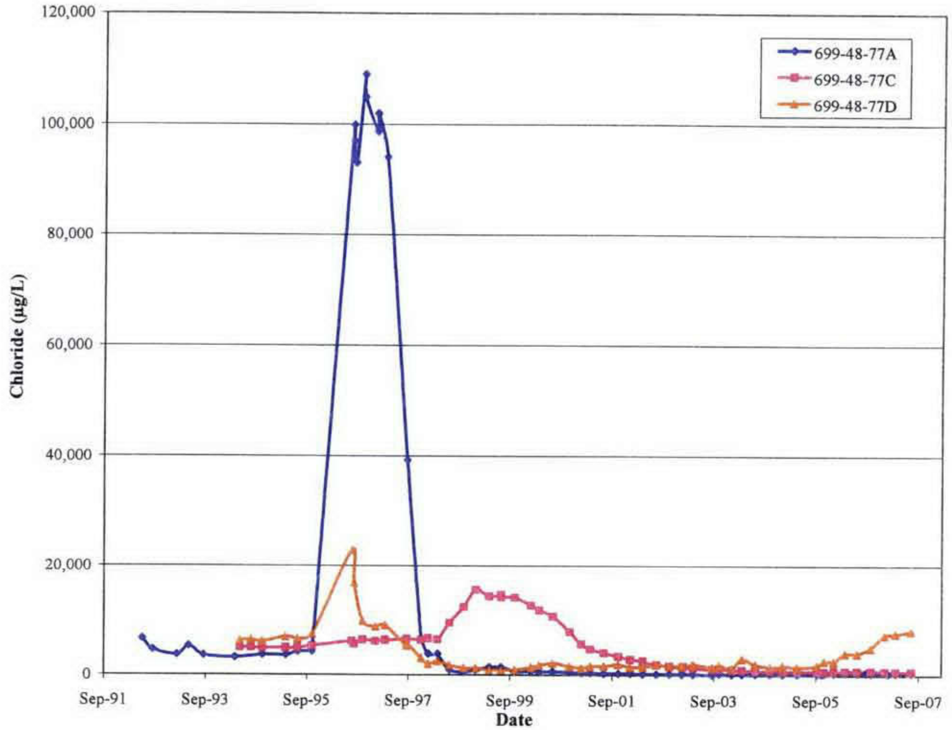


Figure 3-6. Trend Plots for Chloride (Top) and Sulfate (Bottom) in State-Approved Land Disposal Site Proximal Wells.



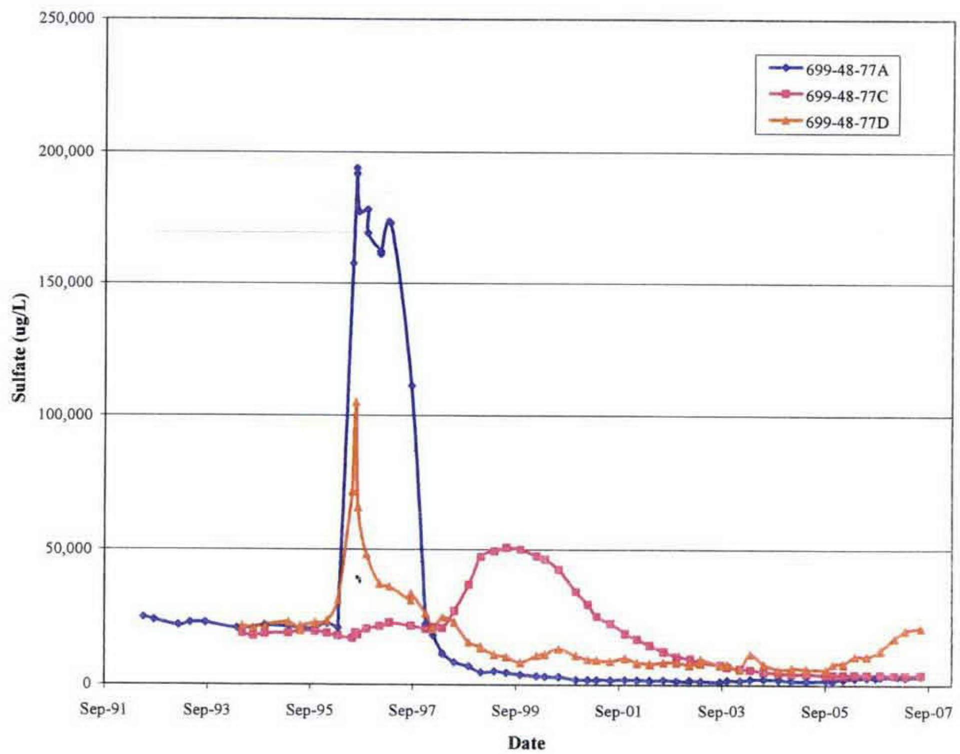
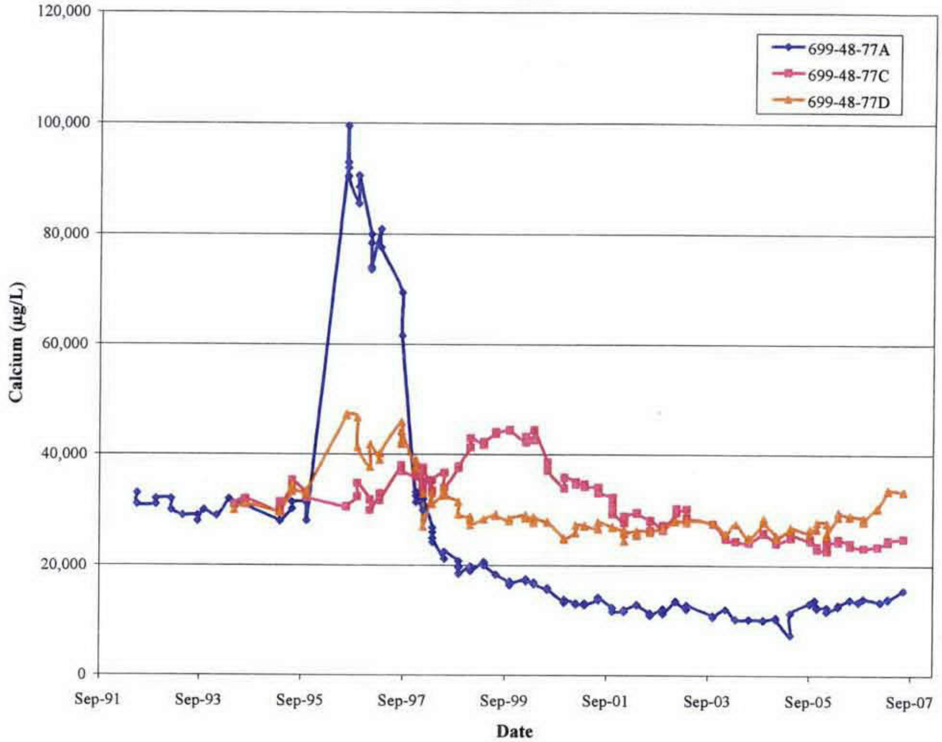


Figure 3-7. Trend Plots for Dissolved Calcium (Top) and Dissolved Sodium (Bottom) for State-Approved Land Disposal Site Proximal Wells.



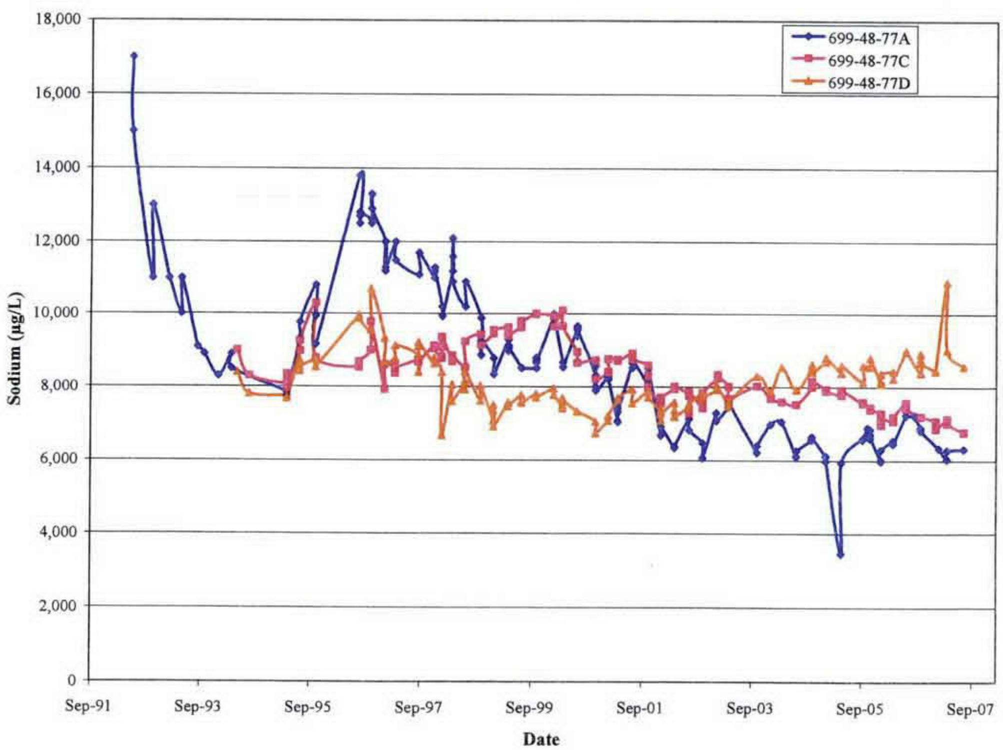


Table 3-1. Sampling Schedule for State-Approved Land Disposal Site Wells.

Well	Sampling Frequency/Months[a]	Other Sampling Programs	Comments
299-W6-6	A / February	Surv-3	Deep companion to well 299-W6-7 (screen 418 to 429 ft).
299-W6-7	A / January	Surv-3	Shallow companion to well 299-W6-6. Sample-dry in 2002. Water level collected to 2004.
299-W6-8	A / January	--	Dry in 2002.
299-W6-11	A / February	--	--
299-W6-12	A / February	Surv-3	--
299-W7-1	A / January	LLBG	Sample-dry in 2004; dry well in 2006.
299-W7-3	S / February, May	LLBG	Deep completion.
299-W7-5	S / March, September	LLBG	Sample-dry in 2005. Water level dry in 2007.
299-W7-6	S / January, July	LLBG	Dry in 2003; plugged with bentonite.
299-W7-7	S / January, July	LLBG	Dry in 2004.
299-W7-8	A / January	LLBG	Dry in 2002.
299-W7-9	A / January	LLBG	Dry in 2003.
299-W7-11	S / January, July	LLBG	Dry in 2002.
299-W7-12	A / January	LLBG	Sample-dry in 2005. Water level monitored in 2007.
299-W8-1	A / February	LLBG	Suspected dry in September 2007.
699-48-71	A / January	Surv-3	--
699-48-77A	Q / October, February, April, July	Surv-3	Sampled for tritium and 15 constituents required by Permit.
699-48-77C	Q / October, February, April, July,	Surv-3	Sampled for tritium and 15 constituents required by Permit. Deep completion
699-48-77D	Q / October, January, April, July,	Surv-3	Sampled for tritium and 15 constituents required by Permit.
699-49-79	A / January	Surv-3	--
699-51-75	S / January, May,	Surv-3	--
699-51-75P	A / February	--	Deep piezometer in well 699-51-75 .

NOTE: Wells 299-W7-2 and 299-W6-5 were included in the original network of tritium-tracking wells south of the State-Approved Land Disposal Site facility (PNNL-11665). These wells went dry in 1997 and 1996, respectively.

[a] Actual months of sampling may vary slightly due to winter weather or accessibility restrictions caused by fire hazard; however, sampling frequency is maintained.

A = annual
LLBG = Low-Level Burial Grounds
Q = quarterly
S = semi-annual
Surv-3 = Hanford Sitewide surveillance triennial sampling

Table 3-2. Maximum or Range of Concentrations of Constituents in Groundwater and Corresponding Sample Month for State-Approved Land Disposal Site Wells, Fiscal Year 2006.

Constituent (Permit Limit)	Well 699-48-77A	Well 699-48-77C	Well 699-48-77D
Acetone (160)	<1.0 (U)[a]	<1.0 (U)[a]	<1.0 (U)[a]
Benzene (5)	<1.0 (U)[a]	<1.0 (U)[a]	<1.0 (U)[a]
Cadmium, total (10)	<0.1 (U)[a]	0.1 (U)[a]	0.1(U)[a]
Chloroform (6.2)	<0.1 (U)[a]	<0.1 (U)[a]	<0.1 (U)[a]
Copper, total (70)	3.29; February 2007	0.51; April 2007	0.97; April 2007
Lead, total (50)	1.69; February 2007	<0.1 (U)a	0.12; January 2007
Mercury, total (2)	0.07; February 2007	<0.05 (U)	<0.05 (U)
Laboratory pH, pH units[b] (6.5 to 8.5)	7.37 to 8.22	7.33 to 8.18	7.53 to 8.18
Field pH, pH units[b] (6.5 to 8.5)	8.18 to 8.22	7.99 to 8.20	8.06 to 8.18
Sulfate (250,000)	3,405: July 2007	3,820; October 2006	21,040; April 2007
Tetrahydrofuran (100)	<2.9 (U)[a]	<2.0 (U)[a]	<2.0 (U)[a]
Total dissolved solids (500,000)	160,000; February 2007	153,000; April 2007	199,000; July 2007
Gross alpha, pCi/L[c]	1.3 (U); April 2006	2.3; January 2007	2.1; January 2007
Gross beta, pCi/L[c]	4.4; February 2007	15.0; October 2006	4.5; October, 2006
Strontium-90, pCi/L[c]	3.2 (U)	3.3 (U)	1.8, October 2006
Tritium, pCi/L[c]	56,000; July 2007	82,000; October 2006	130,000; April, July 2007
Alkalinity, mg/L[b, d]	68 to 73	100	110
Field conductivity, µS/cm[b, d]	136 to 145	203 to 206	255 to 286
Dissolved oxygen, mg/L[b, d]	9.88	8.91	10.61
Field temperature, °C[b, d]	20.3 to 23.8	17.1 to 18.9	16.9 to 18.8
Turbidity, NTU[d, e]	3.02 to 13.8	0.41 to 0.97	4.32 to 4.65

NOTE: All concentrations in µg/L, unless noted.
[a] Not detected in any sample.
[b] Range of quarterly averages (pH, conductivity, dissolved oxygen, and temperature) or values (alkalinity) for fiscal year 2006 (October 1, 2006, through July 30, 2007).
[c] Constituent is not assigned an enforcement limit, but is subject to routine monitoring and reporting.
[d] Constituent is sought for evaluation of groundwater character and analytical quality and is not subject to *State Waste Discharge Permit Number ST-4500* conditions (Ecology 2000).
[e] Maximum value at time of sampling.
(B) = detected above instrument detection limit but below contract-required detection limit
(J) = estimated quantity
NTU = nephelometric turbidity unit
(U) = not detected; multiple minimum detection limits or lower thresholds of detection are indicated, where applicable

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4.0 SITE ANALYSIS AND CONCLUSIONS

The regional decline in the water table in the 200 West Area has reduced the number of tritium-tracking wells located south of the SALDS to four or five: 299-W8-1 (suspected dry), 299-W7-3, 299-W6-12, 299-W6-11, and 299-W6-6. All of these wells are located along the northern edge of the 200 West Area and LLBG-3/5. Because of the close spacing of wells in this area, the loss of wells is becoming more critical for tracking the tritium plume that is originating from the SALDS. The discussion presented in this section focuses on additional topics that may have the greatest effects on SALDS operation.

4.1 NUMERICAL MODEL COMPARISONS

The simulated tritium plume, as defined by the 500 pCi/L contour, should reach the line of tritium-tracking wells along the northern border of the 200 West Area between the years 2020 and 2030 (Figure 4-1) (PNNL-14898). Previous modeling simulations using higher tritium inventories and liquid waste volumes (PNNL-11665) predicted that the plume would reach the northern boundary of the 200 West Area between the years 2000 and 2005.

Wells 299-W7-7 and 299-W7-6, located south of the SALDS, were also predicted to detect tritium from the facility by calendar year 2000, but tritium was not detected in these wells prior to their going dry in 2003 and 2004, respectively. Modeling of the vertical distribution of tritium beneath the SALDS predicted activities of >200,000 pCi/L at well 699-48-77C, which is screened approximately 45 m (148 ft) below the top of the aquifer. The maximum tritium activity in this well was 980,000 pCi/L in February 2001 but has slowly risen through FY07 to 56,000 pCi/L (July 2007).

It should be noted that although actual discharge volumes to date are in line with model assumptions, the model assumed that a total of approximately 745 Ci would be discharged to the SALDS by the end of calendar year 2002. This compares to the 402 Ci discharged thus far, which may eventually result in a disparity between the activities observed in the tritium-tracking wells versus the predicted activities.

The predicted hydraulic potential distribution in the area surrounding SALDS for 2005 (Figure 4-2) is approximately 2.0 to 2.25 m (6.6 to 7.4 ft) higher than current field-derived measurements (Figure 2-4). Also, the March 2007 water table surface indicates a more easterly component of flow in the vicinity of the SALDS than model predictions for the 2005 water table surface. The more easterly regional groundwater flow could be a factor in explaining why higher tritium concentrations have not been detected in the tritium-tracking wells located south of the SALDS.

Despite some discrepancy between the predicted hydraulic potential distribution in the model predictions and the observed water levels in March 2007, the 2004 model is a reasonable estimate of hydraulic head and tritium dispersal in the SALDS area. The updated model incorporates recent refinements to the Hanford Sitewide groundwater model and the actual water volume and tritium release information available through June 2004. Future updates to the model need to consider the future effects of pump-and-treat activities around the 241-T tank farms on the SALDS tritium plume.

4.2 CONCLUSIONS

The SALDS tritium-tracking network south of the SALDS is now comprised of eight wells (excluding the three proximal SALDS wells). Thus far, the remainder of the network appears adequate to track tritium from the facility for the near term. Wells 299-W6-11 and 299-W6-12 are the most advantageously positioned to detect any tritium migrating to the south of the SALDS facility. Tritium has been detected in the LLBG wells to the south at low concentrations, but this is attributed to a 200 West Area tritium plume that was in existence prior to operation of the SALDS.

A consistent downward hydraulic head is indicated by the head differences between shallow proximal wells (699-48-77A and 699-48-77D) and the deep proximal well (699-48-77C). However, due to 2 years of low, sporadic discharges to the waste site, this gradient has declined from past levels. This gradient has forced tritium deeper in the aquifer in the immediate vicinity of the facility, although at lesser concentrations. South of the SALDS mound, the vertical hydraulic gradient appeared to be negligible at wells 299-W6-6 and 299-W6-7 through March 2004, when the last water level was measured in well 299-W6-7.

In general, tritium activities in most wells near the SALDS either show a long-term decline or are unchanging. Tritium activity in well 699-48-77A has reversed its decline, with a small increase from 32,000 pCi/L in July 2006 to 56,000 pCi/L in July 2007. These fluctuations appear to be an adjustment in tritium concentrations reflecting the cessation of 200-UP-1 processing campaigns with releases of more concentrated 242-A evaporator process and K Basins liquid waste streams. To date, although individual wells may increase slightly from year to year, no positive indications of tritium incursions have been detected in the tritium-tracking network.

During the past few years, concentrations of sulfate, specific conductance, and total dissolved solids have declined and are now below background levels in the three SALDS proximal wells. This is because the dilution of the groundwater in the vicinity of the SALDS has now replaced the earlier plume of soil-derived dissolved solids.

If the water decline continues at the current rate (0.27m/yr [0.9 ft/yr]), only the wells screened deep in the aquifer will survive to beyond the year 2020, when in accordance with 2004 numerical simulations, the tritium plume is expected to reach the northern boundary of the 200 West Area.

Figure 4-1. Predicted Tritium Distribution as a Result of State-Approved Land Disposal Site Operation in Years 2020 (top) and 2030 (bottom) (PNNL-14898).

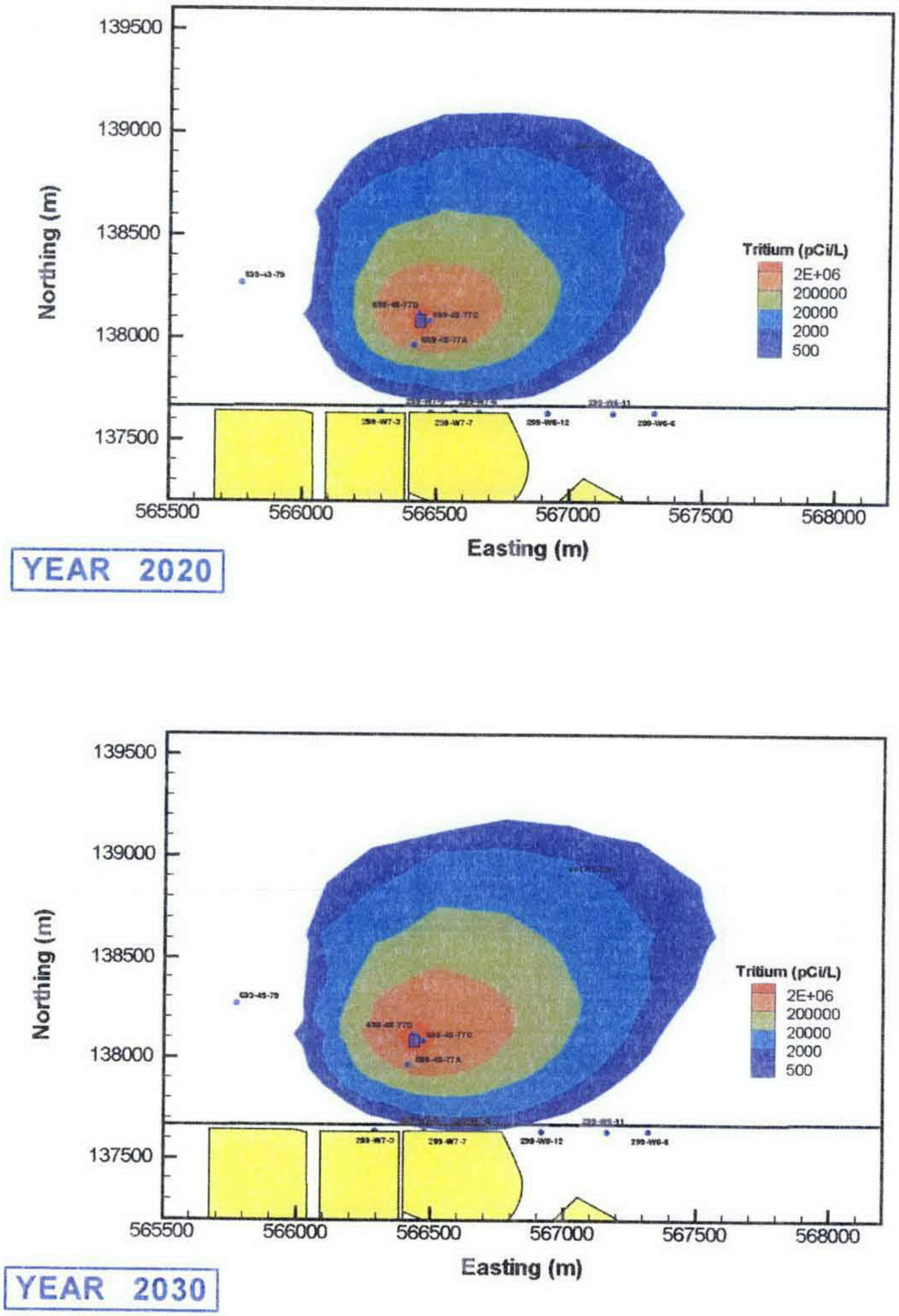
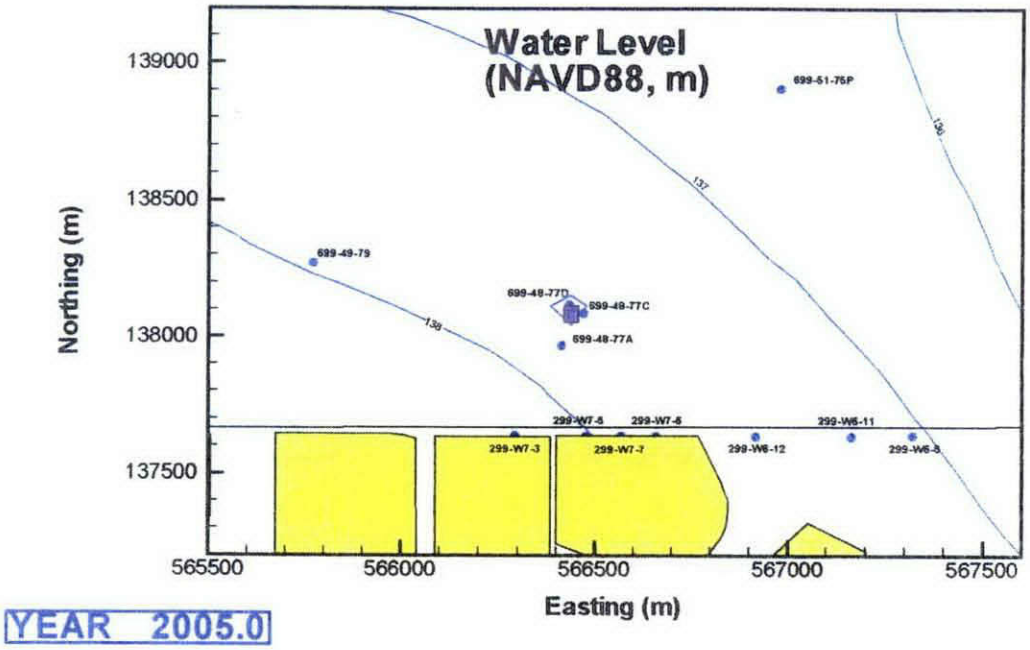
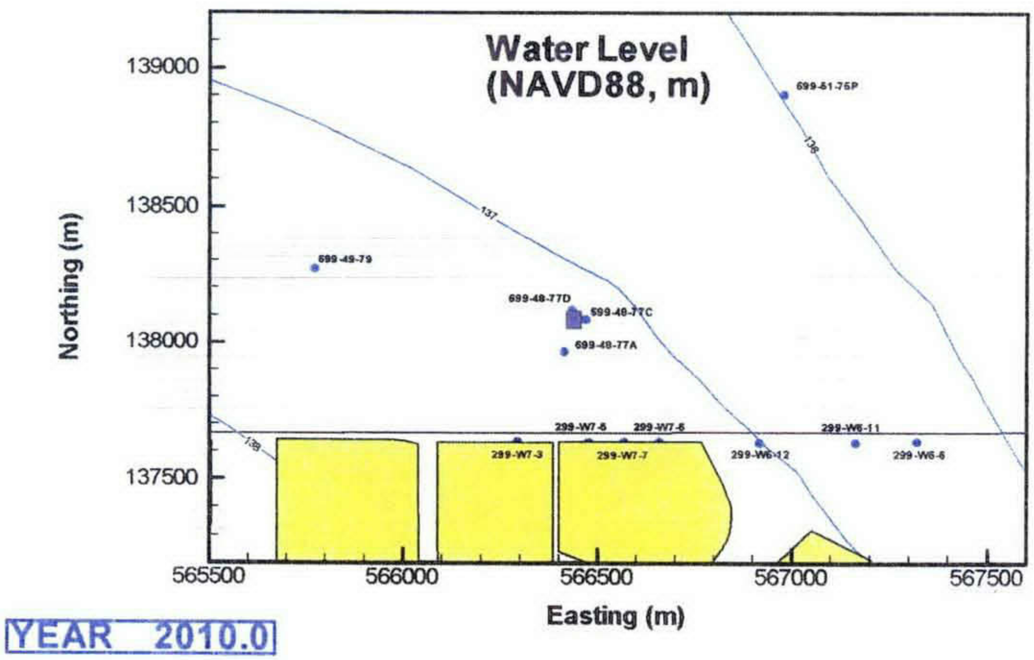


Figure 4-2. Hydraulic Head Distribution Predicted for SALDS in Years 2000 (top) and 2005 (bottom) (PNNL-14898).





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APPENDIX A

STATE-APPROVED LAND DISPOSAL SITE TRITIUM RESULTS FOR FISCAL YEAR 2007

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Table A-1. State-Approved Land Disposal Site Tritium Results, Fiscal Year 2007.

Well	Date Sampled	Tritium (pCi/L)	Qualifier	2007 Max. vs. 2006 Max.	2007 Yearly Avg. (pCi/L)
299-W6-11	02/07/07	3,290		Unchanged	3,290
299-W6-12	02/07/07	263		Unchanged	263
299-W6-6	02/07/07	13.3		Increased	13.3
299-W7-3	10/26/06	383	U		
	02/27/07	10.9			
	03/28/07	301	U		
	05/14/07	19.6		Increased	-15.3
299-W8-1	10/26/06	380	U		
	11/17/06	150	U		
	02/07/07	38.3			
	05/03/07	27.9	U	Decreased	38.3 (U)
699-48-71	11/09/06	633			
	01/02/07	623			
	01/17/07	638			
	06/30/07	640			
	06/30/07	610		Unchanged	630
699-48-77A	10/09/06	36,000			
	02/07/07	39,000			
	04/03/07	43,000			
699-48-77A	07/23/07	56,000		Decreased	43,500
699-48-77C	10/09/06	82,000			
	02/07/07	80,000			
	04/3/07	76,000			
	07/23/07	73,000		Decreased	77,800
699-48-77D	10/09/06	94,000			
	10/09/06	110,000			
	01/17/07	120,000			
	04/03/07	130,000			
699-48-77D	07/23/07	130,000		Increased	120,500
699-49-79	01/18/07	5.42	(U)	Unchanged	5.42 (U)
699-51-75	05/01/07	8.87		Increased	8.9
699-51-75P	02/07/07	8.76		Increased	8.8

NOTE: Increase = χ 20% higher maximum concentration in 2007 than 2006; decrease = α 20% lower maximum concentration in 2007 than 2006; unchanged = 2007 maximum within 20% of 2006 maximum.

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